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DISCOVERY

A Monthly Popular Journal of Knowledge

Vol. IX. No. 98. FEBRUARY, 1928. PRICE 1s. NET

THE FUTURE OF CIVIL AVIATION
(see page 55).

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Before his death Sir Arthur had fortunately named a collaborator in Mr. Carl Pantin, of the Plymouth Marine Laboratory, who has, therefore, brought the work up-to-date, and contributed an original introduction. As with Sir Arthur's most recent biological work, "Life," on which Mr. Pantin also co-operated, the new book is popularly written for elementary students, but it will no doubt be equally sought after, to quote the author once again, by "the public that is not preparing for examinations and, thank heaven, that public is still in the great majority."

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DISCOVERY

A Monthly Popular Journal of Knowledge

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Editorial Notes.

To those not actually engaged in research, discoveries appear to follow in such rapid succession that it becomes increasingly difficult to comment on the significance of a particular period. Yet it may well be that in retrospect the most important feature of the past year will be seen to be the vigorous development of scientific method in nearly all branches of industry. To the layman, research in the past has on the whole been synonymous with the efforts of academic workers to extend the frontiers of pure knowledge. One of the most striking and heartening features of modern industry, however, is the application of the scientific spirit and methods to practical and immediate problems. It is not so much a question of new orientation as the apprehension of the distinction between an immediate goal and a more remote one, a question of focus. Research is discovery in the making, and while discovery sometimes appears to be the result of chance it is much more often the result of organized and sustained effort. If chance intervenes, it favours the prepared mind. The realization of the fundamental importance of research—that is, of strict scientific inquiry into practical problems—is made abundantly clear by the character and increasing numbers of the organizations created to pursue it. In addition to the government departments directly concerned with building, chemical, fuel and food research, there are now industrial research associations covering all the important phases of industrial activity in this country. Thus we have associations dealing with cast-iron, non-ferrous metals, cotton, leather, linen, rubber, silk, wool, glass, refractories, flour, confectionery, and the laundry.

* * * * *

The past year saw the launching of a scheme of Imperial research concerned partly with marketing investigations, but more specifically with the problems of agriculture, of animal breeding, with fruit research and problems of storage. It is further significant that during 1927 Imperial Chemical Industries Ltd., representing the largest group in this country of industrial activities based on scientific knowledge, has created a research council consisting in part of distinguished men of science trained in industrial operations, and in part of university professors engaged in academic work but highly sympathetic to practical problems. Lastly, the past year has seen a notable advance in international scientific relations. International congresses were held at Prague, at Berlin, and at Budapest, and these brought together in friendly intercourse workers from all the countries which the events of 1914-1919 had so deeply separated.

* * * * *

If one single feature of this increased activity had to be selected both for its diffusion and significance it would probably be fuel research. This is partly due to the consciousness of dwindling resources in fuel, both solid and liquid, but perhaps even more to the widespread public feeling that our present methods of using solid fuel are wasteful and insanitary. A superficial survey of the patent journals of this country, of Germany, France, and the United States, shows how active inventors are everywhere in trying to evolve processes and plant for dealing more effectively with fuel. We publish on page 49 a note on the various fields in which coal research is now being pursued.

* * * * *

For his presidential address to the Classical Association last month, Professor Conway chose as his subject "Poetry and Government," with the subsidiary title "A Study of the Power of Virgil." While it was generally known, he said, that the founder of the Roman Empire between the ages of nineteen

and thirty-four—that is, between 44 and 29 B.C.—went through a process of enlightenment which completely altered his conduct, not everyone realized how directly the Emperor was affected by Horace and Virgil. The evidence suggested that these poets, together with Livy, were the source and centre of what was good in the new Empire. Readers of *Discovery* will recall that Professor Conway recently described the political significance in the writings of Livy, and in the address he proceeded to reveal passages of similar significance in the Georgics and Eclogues. Many of those who listened to the address must have envied his pupils the living interest inspired by this unusual approach to classical studies, which are all too often presented as if they were solely a rather musty relic of the past. As Professor Conway said, if we even dimly realize the power that Virgil wielded to revive a faith in goodness in the hearts of his countrymen and their ruler, we cannot think it superfluous to cherish Virgil as a living teacher to-day.

* * * * *

In the great classical writers, in fact, we have a standard of appeal which, though it may not transcend or equal other influences that have moved mankind, is far less subject to question than any other. While fully recognizing that common efforts to discover the secrets of natural knowledge do bring together different nations, Professor Conway said that unfortunately it is also true that the competition for discoveries which may have enormous financial value, or enormous capacity for mischief in war, may sharpen rather than soften the jealousies of nations. And the same dangers of division beset us, in a more insidious shape, when we appeal to men's highest motives. "But," Professor Conway concluded, "the great ideals of the old world, indissolubly linked with the primitive record of Christianity, are preserved for us in letters of gold, in language that escapes all change; they stand behind and beyond our local habits, and our local forms of creed. To them all the peoples of the civilized world look back; and by them the nations of the future may be inspired and brought nearer to each other."

* * * * *

Some days after our January number appeared containing M. Reinach's article in support of Glozel, the international Commission of inquiry published the following statement: "Basing its decision upon the facts that it has determined, and on the exhaustive discussions it has held, the Commission has come to the unanimous conclusion—subject to the reservations made in its report—that, taken as a whole, the exhibits it has had the opportunity of examining at Glozel are not antiquities." The reservations mentioned relate to certain fragments of flint and stone axes, and pottery, which are regarded as genuine, but it is suggested that all signs point to the other objects having been buried quite recently. Perhaps the strongest evidence mentioned concerns various bone implements which the Commission itself unearthed; although found in the same stratum these show different degrees of fossilization, and there are no marks of roots, such as might be expected from the nature of the site. On the other hand, the Commission offers no explanation of how and when the "recent burial" at Glozel was accomplished, and the puzzle has yet to be solved. Our publication of the "defendants'" case was therefore widely commented on as of importance at this juncture.

* * * * *

Two expeditions of unusual interest were described last month to the Linnean Society. In the first place, Mr. C. V. B. Marquand communicated a paper on the botanical collection made by Captain F. Kingdon Ward in the Eastern Himalaya and Tibet in 1924-25. Captain Ward accompanied the last Mount Everest expedition when it started out from Darjeeling, then travelling in an easterly direction from Gyantse to Tsetang over unexplored ground. Next, crossing the Temo La to Tumbatse he entered the region in the neighbourhood of latitude 29° 40′ N., longitude 95° E., where the most important part of the collection was made. A short distance east of Tumbatse a number of high passes over the eastern extremity of the Himalaya were traversed. On the return journey through Bhutan several species were found which had not been collected since they were discovered by Dr. Griffith nearly a century ago.

* * * * *

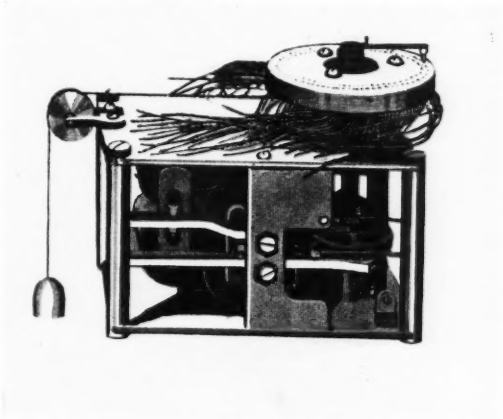
Insect-collecting in the Southern Andes was next described by Mr. F. W. Edwards. The expedition was a joint one arranged by the British Museum and the Bacteriological Institute of Argentina, its object being to make investigations on the mosquitoes and other bloodsucking flies of the Southern Andes, and to form a general collection of insects from the southern beech-forests. Very little work had been done on the insect fauna of this region since the time of Philippi, whose results were published in the middle of last century, and it was believed that much of interest remained to be discovered. Two and a half months, from October, 1926 to January, 1927, were devoted to collecting, most of the time being spent around Lake Nahuel Huapi. From here the party worked their way across to the Chilean coast through extremely interesting and beautiful country. The route taken was the regular one over the Perez Rosales Pass, now increasingly used by tourists.

The Automatic Telephone and How it Works.

The Strowger System.

The development of the automatic telephone, instituted in London at the Holborn exchange a few weeks ago, covers half a century of research. It is hoped to extend the system gradually throughout the Greater London area of more than seven hundred square miles.

FROM the automatic telephone as we know it to-day to the crude product of an inventor forty years ago is a far cry, and the intervening period is rich in records of industry and persistence in research. The Strowger automatic telephone takes its name from Almon Strowger, an undertaker of Kansas City, Missouri, U.S.A., and owes its inception to a suspicion in his mind that a telephone operator was conspiring with one of his competitors to report the Strowger line "busy" whenever prospective customers rang him up, thus diverting his business into alternative channels. The suspicion proved to be unfounded, but it nevertheless inspired Strowger, little as he must necessarily have known of telephony or mechanics, to try his hand at inventing. History records that his raw materials comprised a round collar box, a packet of pins, and a pencil. Details are lacking, but we may postulate that this undertaker-inventor was conversant with the broad principle of manual telephone switching, by means of plugs and cords inserted in metal sockets representing the fixed terminals of subscribers' lines at the telephone exchange, and that he visualized an alternative electro-mechanical rotary switch, in which the pins, stuck round the collar box at regular intervals, constituted subscribers' fixed line terminals, any one of which could be selected at will by a radial contact arm arranged to sweep round the circle.

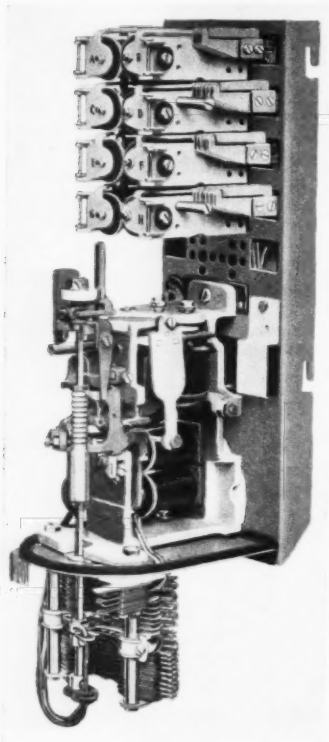


THE FIRST AUTOMATIC SWITCH.
This was used at La Porte, Indiana, U.S.A., in 1892, and consisted essentially of a flat ebonite disc (seen at the top). The rotating arm makes contact with the terminals of the numerous lines.

Strowger, however, made no material progress with his invention until chance brought him in contact with Joseph Harris, then a young commercial traveller, to whom the crude switch was shown merely as a matter of interest and its purpose explained. There, in all probability, the matter would have ended but for an experience which befell Joseph Harris a few days later. Harris knew even less than Strowger about telephones or mechanics, but he possessed imagination, and having occasion to make a telephone call from a small exchange at Carthage, Missouri, he witnessed a flagrant case of inattention on the part of the operator, who was gossiping instead of attending promptly to calls as they came in. The incident recalled his talk with Strowger, and prompted the thought that there were possibilities ahead for the collar-box switch. To confirm his theory he made inquiries as he travelled, improving his knowledge of telephonic matters, but experiencing no enthusiasm regarding the success of Strowger's invention, then considered an impracticable and valueless idea.

All this happened in 1889, but two years later Harris succeeded in floating a company called the Strowger Automatic Telephone Exchange, of which Strowger and he were vice-president and secretary respectively. Manufacturing difficulties followed, and their efforts to interest various existing organizations brought the inventor and promoter into contact with A. E. Keith, a young engineer with whom they joined forces, and to whom belongs much of the credit for putting Strowger's idea into practical shape.

Three years later, in 1892, the installation was commenced of the first public automatic exchange at La Porte, Indiana. The Strowger switches used in those days took the form of a flat ebonite disc, around the circumference of which were arranged contacts corresponding with the terminals of the subscribers' lines. The rotating member or contact arm was mounted on a shaft which passed axially through the centre of the disc, rotary motion being imparted to it by two pawls actuated by electro-magnets.



MODERN STROWGER SWITCH.

The inventor's early idea of a central spindle or rotating shaft is still embodied. The working details are shown in the line diagram below.

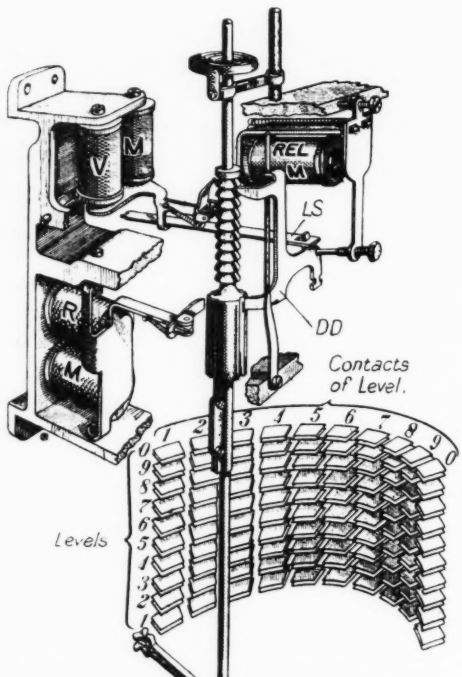
One magnet-pawl combination moved the contact arm over ten contacts at a time; the other stepped it only from one contact to the next. A third electro-magnet released the mechanism by disengaging both pawls, allowing the contact arm to restore to normal, ready for another call.

To actuate this early Strowger switch, no less than five line wires were required from each telephone to the exchange, whilst every subscriber had the sole use of one of these switches, an obviously costly arrangement seeing that many of the switches would be standing idle for the greater part of the day. Moreover, there was no convenient numbered dial in those days for simplifying the calling operation. Each telephone was fitted with keys or push-buttons on which the subscriber, after the manner of a telegraph operator, tapped out the electrical impulses necessary to set up the desired connexion.

In spite of these complications the La Porte exchange worked successfully and gave satisfaction to its subscribers. It was realized, however, that drastic improvements and greater simplification would be necessary to fit the automatic telephone for public service on a large scale. The early principle of individual switches limited the capacity of an exchange, and it was not until the principle of trunking by groups—arranging subscribers terminals in groups and providing facilities for inter-connecting the groups—was introduced, that real progress was made. Meanwhile the Strowger switch had been steadily developed and improved in detail until in 1902 it took a form which, though differing radically from the original, was the prototype of those in general use to-day.

The modern Strowger switch, or "selector," as it is termed, still incorporates the inventor's early idea of a central spindle or rotating shaft, a radial contact arm and contacts arranged circumferentially. To-day however, the shaft is capable of motion in two planes, vertical and horizontal, whilst the contact arm has access to one hundred sets of contacts per switch. These may be either the terminals of subscribers' lines, or communicate in turn with other groups of Strowger switches, thus indefinitely extending the capacity of the exchange of which they constitute the equipment.

The contacts are arranged in ten rows or "levels" considered vertically, each level comprising ten sets of contacts. Thus grouped they lie, as it were, on the inner face of a semi-cylinder. The rotating shaft is vertical and constitutes the axis of the cylinder, the radial switch arm being rigidly attached to it. Combinations of electro-magnets and pawls move this

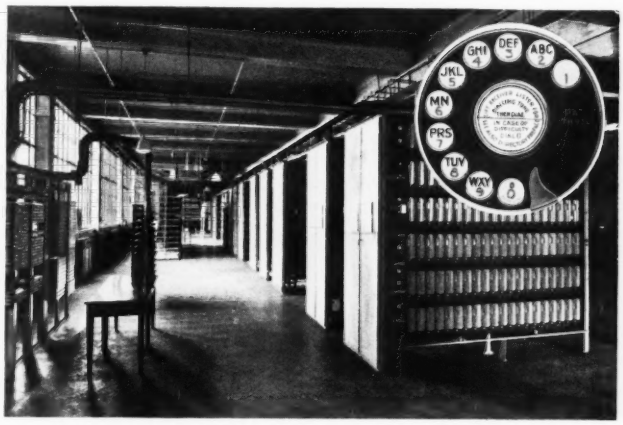


PRINCIPLE OF SWITCH OPERATION.

The shaft is stepped up by the electro-magnet VM, and stepped round by the electro-magnet RM. A third electro-magnet, RELM, effects the release when the subscriber replaces the receiver.

shaft step-by-step, both vertically and horizontally, thus enabling the switch arm or "wiper," as it is called, to sweep over the entire one hundred sets of contacts, selecting and coming to rest on the particular set indicated by the subscriber in dialling the required number.

The vertical movement of the shaft is analogous to that of the monkey-on-a-stick, familiar as a nursery toy, while the subsequent rotary movement resembles that of the hands of a clock, except that less than a half-circle is traversed by the wiper. A spring, assisted by gravity, restores the switch to normal when the subscriber hangs up his receiver, release being effected by a pawl under the control of a third electro-magnet. Such, in effect, is the Strowger switch of to-day, but the subscriber no longer commands one of these ingenious mechanisms for his own exclusive use.



THE HOLBORN AUTOMATIC TELEPHONE EXCHANGE.
This view of the first public service exchange in London shows the many rows of automatic switches. Inset is the standard dial fitted to subscribers' instruments.

Keith, the first engineer associated with Strowger, introduced what has come to be known as the line switch, a much simpler and less costly piece of apparatus on which each subscriber's line terminates. This later development really made the invention commercially practicable, because it immediately reduced the number of switches to those necessary to carry the known traffic, thus approaching nearer to that ideal when the maximum of exchange equipment is in service throughout the periods of busiest traffic. The function of the modern line switch, which now takes a different form to Keith's original model, is to select and retain for the exclusive temporary use of the calling subscriber a disengaged Strowger switch or selector, and it performs this function automatically in response to the lifting of the receiver from its hook.

As regards the subscriber's part in automatic telephony, it was soon realized that the method of selecting numbers by pressing a series of numbered keys or buttons on the telephone was too primitive and involved the user in too complex a method by comparison with the manual exchange system. Gradually the simple and reliable calling dial as we know it to-day was evolved, with its ten finger holes and numbered disc, which considerably facilitated the act of telephoning.

Without going into technicalities, all that the automatic telephone dial does when one releases the disc, after having moved it round with the finger-tip, is momentarily to break or disconnect the line circuit a number of times corresponding with the number dialled. These interruptions in the otherwise steady flow of current over the line give rise to the electrical "impulses" which in turn actuate the Strowger switches at the exchange, causing the shafts to step up and step round until the contact arm of the final switch in a series rests on the terminal contacts corresponding with the required number.

Like all innovations, the automatic telephone was regarded askance by telephone authorities for some years after its invention. Only the smaller independent operating companies in America could be prevailed upon to give it a trial, but slowly and surely its principles were accepted, and wherever it was installed the service improved. When, in 1911, the lease of the then National Telephone Company expired, and the British telephone service reverted to the State, Strowger development had reached a point where its introduction into Great Britain and the colonies appeared opportune.

To facilitate matters and provide a British source of production to meet the stipulation of the British Post Office Telephone Department that all its equipment should be of home manufacture, a British company was formed and in 1912 entered into negotiations with the British Post Office. As a result the Strowger automatic telephones were installed at Epsom, and experimentally at the G.P.O., London. So satisfactory did these initial exchanges prove that they were quickly followed by others at Newport, Accrington, Paisley, Blackburn, Portsmouth, and Leeds. Meanwhile the British sponsors of Strowger automatic telephones had also turned their attention to the Colonies and foreign territories, and as a result equipment was introduced into India, Manchuria, Japan, the Argentine, and other countries.

Up to this period, some six years ago, while not limited to cities of any particular size—the telephone needs, for example, of such metropolitan areas as Buenos Aires and Los Angeles had been successfully catered for—applications of the automatic telephone were restricted by a lack of flexibility. In the largest centres of population, where manual telephone development had already reached considerable proportions, grafting the Strowger system on to the existing network involved wholesale and drastic alterations in exchange names, together with costly modifications in underground cable and wire plant. Had London been devoid of telephone exchanges in the face of its immediate and urgent need for more than half a million telephones, it would have been a straightforward proposition to satisfy this requirement by applying existing Strowger practice.

The New London System.

Under these theoretical conditions the planning of an automatic telephone system for London would have permitted the establishment of an exchange nomenclature and an interconnecting cable and line plant in harmony with known Strowger features. In point of fact, when the proposal to introduce automatic telephones into London was made, more than seventy-five manual telephone exchanges were already in existence in the area ; and these telephone centres with their associated cables and line plant possessed considerable inertia and resistance to the changes involved by the introduction of the automatic system then available. Applying the Strowger principle, in the past it had sufficed to provide means whereby a telephone user could at will select any number connected with his own exchange, or, in a multi-exchange area, could first select the particular exchange in which the wanted subscriber's line terminated, and then automatically connect his telephone with that of the wanted subscriber.

To afford satisfactory telephone service for London on a basis acceptable to the Post Office as the responsible telephone administration, it was necessary for the automatic system to maintain all these facilities without undue interference with existing exchange nomenclature or the junction cables interconnecting the exchanges. Undismayed by this complex problem the Strowger engineers in England and America, some of whom had virtually grown up with the invention which they were sponsoring, set about the task, and, still retaining the switch as a basis, evolved a combination of apparatus known as the " Director " register controller which abundantly justifies Dr. Fleming's eulogy as representing " the high water mark of human creative power."

Operating under the control of a numbered *and lettered* dial attached to the subscriber's telephone the " Director " register controller selects and connects with a telephone wire route from, say Bow to Battersea ; from Mayfair to Whitechapel ; in short, from any district in London to any other district. This accomplished, the Strowger switches on the spot do the rest, by selecting and connecting with the terminals of the particular subscriber in that district. All this occurs at the bidding of a numbered and lettered dial, on which letters representing exchange names have been introduced for the sake of simplicity. Psychology suggests that it is easier for a person to memorize a series of letters and numerals, than a full series of numerals only, especially when he is already conversant with telephone exchange names.

It is, moreover, possible by dialling a combination of three letters, representing the exchange name and four numerals of a given subscriber's number associated with that exchange, to generate, if necessary, a still larger number of impulses required to route the call to the district desired. To describe in detail how this is accomplished by means of the register controller is outside the scope of this article, but it will suffice to mention that this latest adaptation of Strowger principles can receive one series of impulses from the subscriber's dial ; translate it into an entirely different series without mutilation or interference with the numeric portion ; and having passed it on to the particular exchange for which it was destined, immediately disconnect and place itself at the disposal of the next subscriber waiting to call.

The opening of the new automatic exchange at Holborn—the consummation of an undertaker's dream of forty years ago—marks only the inception of a scheme which will ultimately extend throughout the telephonic area of Greater London, embracing no less than 750 square miles and already serving upwards of half a million subscribers.

Cables and Wireless.

THE working relations of cables and wireless are again under discussion, following proposals initiated by certain British submarine cable companies with a view to securing co-operation with the " beam " wireless services. It was announced last month that a joint inquiry was to be undertaken as to a possible arrangement which might be to the advantage of both interests. The matter raises the problem that results from nearly every discovery—how far existing appliances can be related to new developments.

A New Conception of Pope.

By A. G. McL. Pearce Higgins, M.A.

Pope has suffered in the modern tendency to misinterpret the eighteenth century, but is this attitude based on sufficient consideration of the facts? The author suggests that our judgments to-day are bound by rules no less tyrannical than those we imagine to have been self-imposed on Pope and the writers of his period.

POINTS of view are ever shifting, and an aspect all but ignored by one generation will by another be highly emphasized. In common with many other good things of the past, the eighteenth century has of late fallen somewhat into disrepute, and its chief representative, Pope, has shared in the general contempt with which, since Keats, Shelley, and Wordsworth showed the way, it has been the fashion to load that incomparable age. It is the object of this article to suggest that our attitude is based on insufficient consideration of the facts. We have become biased in our judgment from various causes. We have forgotten that "classical" and "romantic" are complementary terms and not opposed. Even if these aspects of poetry were irreconcilable, there is still enough romantic blood in Pope, and abundant evidence that, had he so willed it, he could have used it more generously, to justify us in refusing to allow ourselves to be misled by the prejudices of the writers of the romantic revival. If the truth be told, we are bound in our judgments to-day by rules just as tyrannical as those which we imagine to have been self-imposed on the writers of the eighteenth century. We have but exchanged the slogan "Write correctly" for another, "Write as you please."

Barbarism of Previous Ages.

The poets of the Romantic Revival imagined that they were doing an inestimable service to English literature in freeing it from what they called the fetters of conventional diction, of prosy and dull complaisance in the accepted order of things. They failed to see that they themselves were following in the old direction, though on a new path. Pope believed that he was freeing the language from the barbarism of a previous age; so did Wordsworth, but he quite forgot that had it not been for Pope's previous purgation his own would probably have been quite impossible.

The romantic poets considered the poetry of Pope to be artificial, passionless, and insincere; that "the poetry of the heart" was the only possible kind, and that without perfect freedom in expression and subject matter poetry would be, or rather would continue to be, the lifeless thing it seemed in the hands of Pope and his more successful imitators. Keats in "Sleep and Poetry" exclaims:—

> But ye were dead
> To things ye knew not of—were closely wed
> To musty laws lined out with wretched rule
> And compass vile; so that ye taught a school
> Of dolts to smooth, inlay, and clip, and fit,
> Till like the certain wands of Jacob's wit,
> Their verses tallied. Easy was the task;
> A thousand handicraftsmen wore the mask
> Of poesy. Ill-fated, impious race!
> That blasphemed the bright Lyrist to his face,
> And did not know it—no, they went about
> Holding a poor, decrepit standard out,
> Marked with most flimsy mottoes, and in large
> The name of one Boileau!

This may be fine scorn, but it is far from the truth. The romantic poets failed to realize or appreciate the difficulties against which Pope was contending, and the magnitude of the task he had set himself to perform.

Now Pope, whatever the cause, possessed certain characteristics which there is a tendency to-day to despise. He was a patriotic Englishman who hated hypocrisy and cant, underhand dealings, tyranny, falsehood, and folly; but like most of us he viewed them in a slightly different light if they were likely to be present helps in time of trouble. Hence his apparent lack of morality in dealing with rogues and scoundrels is supposed to be the measure of the man. And yet with the exception of his patriotism—where he would have had more ground and excuse for being unpatriotic than Shelley—the minds of these two poets, in certain spheres, worked on not dissimilar lines. What the one partially achieved by satire the other vainly attempted by tirade. The world was too much with and against Shelley, and he deserted the struggle against things to create a world wherein there should be no human opposition. As he says of himself, though the subject is a skylark:—

> Like a poet hidden
> In the light of thought,
> Singing hymns unbidden,
> Till the world is wrought
> To sympathy with hopes and fears it heeded not.

From the seclusion of the Italian coast he hurled his invective against a land that heard him not, he sang his songs unbidden for ears that listened

elsewhere and to other music, and created Utopias for those who were quite satisfied with the life to which destiny had assigned them. But the other, in the heart of London, a Roman Catholic, a member of a heavily penalized sect, spared not to lash vice with the full fury of his scorn, whether he found it in the crowned head of England or the meanest poetaster of Grub Street. Destructive as his criticism nearly always is, he was slowly and surely, with full knowledge of what he was doing, preparing the way for the idealism of Shelley and the higher moral revelation of Wordsworth. Like all truly great poets he was fully convinced that underlying all poetry there must be a basis of moral purpose. He sometimes made the mistake of believing that mere didactic writing was sufficient, that to aim high was to reach high. But he at least avoided the more serious mistake of letting his pen run into words with no serious thought behind them, in the hope that something of worth might therefrom happen into existence.

Pope and Shelley.

It is interesting to compare Shelley and Pope in their treatment of Liberty. To Shelley Liberty meant a revolt against the accepted order of things. To be free was to "defy power that seems omnipotent," human and divine, to resist to the utmost super-imposed authority, and ever to struggle after the ideal of love. Love of what? Perhaps a love of the freedom that should unite the warring nations of earth into one great and peaceful family. But the tragic failure was his inability to realize that love is in itself a most cogent law. He had not learnt the law that service was, and is, perfect freedom; and that very love that he would gladly have died to win eluded him at every turn. But if he never achieved love, he never achieved hate. He howls against the tyranny of kings; they laugh at him. He curses organized religion because it imposes external authority on, and demands obedience from, the human will.

> "Oh, that the pale name of priest might shrink and dwindle,
> Into the hell from which it first was hurled!"

It was vain. But Pope praised, "damned with faint praise," so softly, so subtly, that the strongest armour is pierced, and George, be he First or Second, is left bewildered and helpless, the laughing-stock of the foolish and the wise. Shelley could not achieve the force and bitterness, and perhaps it was well, of these lines from the "Epistle to Augustus" addressed to George the Second, notoriously indifferent to the arts, it is true.

> Oh, could I mount on the Maeonian wing
> Your arms, your actions, your repose to sing;
> What seas you travers'd and what fields you fought,
> Your country's peace, how oft, how dearly bought!
> How barb'rous rage subsided at your word,
> And nations wondered while they dropped the sword!
> How, when you nodded, o'er the land and deep
> Peace stole her wings, and wrapt the world in sleep.

In an epic poem the poet is more the historian of than the commentator upon the events he relates; his own personality must remain in the background. But lyric, satire, and all other branches of poetry are dominated by the personality of the writer. To judge from the great poets, the less the writer obtrudes himself, and his peculiarities, the more success he seems to win. And Pope was a firm believer in self-control. Rightly or wrongly he held that many of his inmost thoughts and longings ought to be suppressed, with the result that even in his most passionate moments there is always a pervading atmosphere of restraint, which is probably one of the reasons why to many he seems passionless, or at least coldly unsympathetic. He felt that he was more usefully employed as an "arbiter morum," a judge of the public taste, a mouthpiece of all that was noblest in the life around him, expressing, as he says:—"What oft was thought, but ne'er so well expressed," than a mere recorder of his own personal feelings and emotions. His attitude towards life, though derived, at times blindly, from his friend Lord Bolingbroke, is clearly shown in his "Essay on Man." Again and again in this poem he stresses the need for moderation and caution. "Know thyself," and then try to accommodate that self to the scheme of things. At the same time, in Browning-like language, he offers a splendid hope: "Man never is, but always to be blessed" is strangely similar to "the best is yet to be."

Principles of Good Art.

Let us evolve a principle, Pope seems to imply; *solvitur vivendo*. While the purpose of this poem, the "Essay on Man," like that of the "Essay on Criticism," is avowedly constructive, much of Pope's finest writing is purely destructive. Not wantonly so; but he seems to have felt that he was performing a more useful service to literature in pulling up weeds than in planting flowers, in combatting the diffuse and erratic straining after effects which characterizes the development of poetry during the greater part of the seventeenth century, rather than in perpetrating a similar style himself, or in experimenting in new forms and styles. He perfected the "Heroic couplet"—no mean achievement—and thereafter devoted his genius to what might be called the consolidation of literature. His chief concern was to foster good

art and exterminate "dullness"; questions of "classical" and "romantic"—whatever those words may mean—did not trouble him. Hence his final appeal to reason rather than to imagination. He trusted his head more than his heart. But when imagination appeals to authority either for guidance or approbation, the result is an inevitable crippling of the intellectual faculties. On the other hand, when it came to a question of the English language, of versification and metrical performance, the authorities to whom he could appeal, Waller and Dryden in particular, were too near him in point of time to have achieved the halo of inviolable sanctity that sat uneasily on the poets of Greece and Rome. Reason triumphed in the long run over imagination; that is perhaps why Pope is rarely considered as a romantic poet, but since he is an indisputable link in the chain that stretches from Chaucer to Tennyson and beyond, a label, though misleading, will not affect his reputation. There is in all he writes the true egoism of a romantic poet, chastened and controlled, but differing only in degree from full-blooded romanticism.

Like Wordsworth he refused to be blinded by passion, and though on occasions hate and anger did for a time obscure his vision and pervert his judgment, there is in much of his writing a pathos that brings him closer to Virgil and Tennyson.

Those lines on Addison:—

> Who but must laugh if such a man there be,
> Who would not weep if Atticus were he?

The whole passage, in fact, is not, as some would have it, a masterpiece of satire and hate at all; it is the heart of Alexander Pope fighting against the head. "Who would not weep?" A grain of conscience turned the satire of an earlier version of those lines:—"Who would not *laugh* if Addison were he?" into his nearest approach to the sublimity of:—"Oh, the pity of it."

Gentler Methods.

Other examples of his gentler methods are not far to seek; perhaps his "Epistle to Addison" on the latter's "Dialogue on Medals" will serve for illustration:—

> A small Euphrates through the piece is rolled,
> And little eagles wave their wings in gold.

The quiet unexpectedness of the little wings waved in gold, the attenuated river rolling across a coin—many have tried and all have failed to excel in this style; it is peculiar to Pope. Again, surely it was to these lines, from the same poem, that Gray turned for inspiration for his famous "Elegy":—

> Perhaps by its own ruins saved from flame
> Some buried marble half preserves a name,
> That name the learned with fierce disputes pursue
> And give to Titus old Vespasian's due.

And the following lines from the "Elegy on an Unfortunate Lady," must be held partly responsible for "All that beauty, all that wealth ere gave," etc.:—

> So peaceful rests, without a stone, a name
> What once had titles, beauty, wealth and fame.
> How loved, how honoured, once, avails thee not.
> To whom related, and by whom begot,
> A heap of dust alone remains of thee,
> 'Tis all thou art and all the proud shall be.

A Positive Belief.

The world was not ready then for "Adonais"; nor had it learnt to mourn with gorgeous and passionate insincerity the failure of its hopes. The hopes and aspirations, the vision and morality of the eighteenth century may well have been stifled, its Christianity a mere dogma; but it held fast to a positive belief in what it considered to be right, rather than to a splendid negation of what it did not definitely know to be wrong. The romantic poets solemnly, and often tediously, proclaimed themselves to be emancipators and reformers. But what did they reform, and Whom did they emancipate, and from what? One is tempted to reply that they freed themselves from one code of rules only to impose on themselves and their inheritors another. They discovered that they could not write "Heroic couplets," and very wisely resolved not to make the attempt. They went further; they decreed that it was wrong to write in "Heroic couplets"—the contorted couplets of Keats are meant to be in imitation of those of Chaucer—because so to do involved the use of an out-of-date and conventional vocabulary. Scenes were to be no longer "rural," nor lawns "enameled," nor forests "sylvan"; the "fair one," the "nymph" was to have another name than Belinda or Chloe; she was to be Miranda, or "Jane with a musical instrument," or Isabella with a lover, or Madelene with a fretted screen. Endymion, Laon, and the old Gods of Greece were to restore the Age of Gold, in spite of the assistance of Don Juan! In place of an artificial language we were to have the sweet simplicity of the rustic—not rural—peasant; the peasant who felt so deeply about Westminster Abbey and Milton and Duty. Truly it was fortunate that Wordsworth forgot his own rules. Everywhere prolixity; the necessity for creating the proper "atmosphere" before the story can begin; everywhere

the trivial magnified, the obvious either expanded or ignored.

No other English poet, as poet, till we come to Tennyson, exercised such a great, though indirect, influence on the life of the country as Pope. Pope's standards of morality, such as they were, appealed to and were accepted by the thoughtful men and women of his day, and his often unacknowledged opinions on political and international subjects commanded the respect of statesmen and politicians.

The Conception of Empire.

The conception of Empire was daily approaching a practicable reality, and Pope reacted in the obvious way. Poets, even when they are most revolutionary, are conservative. The Age of Gold is, according to temperament, yesterday or to-morrow. To-morrow, said Shelley; yesterday, said Keats. Pope, with an eye on the past, tacitly decided to accept the present. Given peace and good government, prosperity would follow; and a systematized method of life which set the good and the bad in their places, and made ample provision for the fool and the genius should, he thought, create a world where, if the gout and dizziness of the head could be abolished, felicity should arrive at perfection. And so we have the "Moral Essays," the "Imitations of Horace," and the "Dunciad." Pope seems to have been more successful than Mr. Shaw in ridiculing the vices and follies of his age. The latter rarely makes us angry; he often makes us laugh with and at ourselves. Mr. Pope, on the other hand, lashed his victims into fury, against himself for his unwarrantable impertinence, against themselves for the weaknesses they were loath to see exposed to the public gaze. And so this little hunch-back, who in later life lacked the physical strength even to dress and undress himself, and whose whole soul cried out to be loved and to love again, lived the greater part of his life on the edge of a wasps' nest. But, if the truth be told, he found, where he could not be loved, a grim satisfaction in the danger of being hated. To be provoked gave him excuse for provoking in return, and he knew in his own soul that he could repay the sting of a wasp with the venom of a snake. And yet, at times, indeed, he did feel the stings, and poured his tale of woe into the sympathetic ears of Dr. Arbuthnot; but he never whined about them; he never, like Keats, made sorrow his mistress and the luxury of despair his wife.

> Oh let me live my own and die so too!
> (To live and die is all I have to do),
> Maintain poet's dignity and ease.
> And see what friends and read what books I please. . .
> Friendships from youth I sought and seek them still;
> Fame, like the wind may breathe where'er it will.
> The world I knew but made it not my school,
> And in the course of flattery lived no fool.

This is not altogether true to fact, because once or twice, as in the case of the unauthorized (?) publication of his letters, he did descend to folly, if to nothing worse; and his almost childish love of mystification served, by obscuring his purposes, to make men believe the worst, and to ascribe to him motives which a more honest course would have shown to be unexceptionable. Poor Pope! He fell from time to time in the service of his own vanity.

It is an amazing fact that the differences rather than the points of similarity between the English poets should have commanded the attention of the critics; and yet each poet has some characteristics, however small, in common with all other poets. It is natural that they should differ as their individuality differs; they will differ as they attempt to perform different tasks; they will differ as generation differs from generation; but in that they are all English poets they are one. And so, knowing the purpose that Pope had in mind when he first began to write, and from which he never swerved, it is surely wiser to find out how far he achieved his own ideals, than to censure him for failing to achieve a task that he would not or could not perform. That he was a supreme satirist, few would deny. But in his own way, he too is romantic. It is not the romanticism of Keats; not the idealism of Shelley; not the transcendentalism of Coleridge; but, much more to the point, it is what it was meant to be, the poetry of Mr. Alexander Pope.

Disputed History.

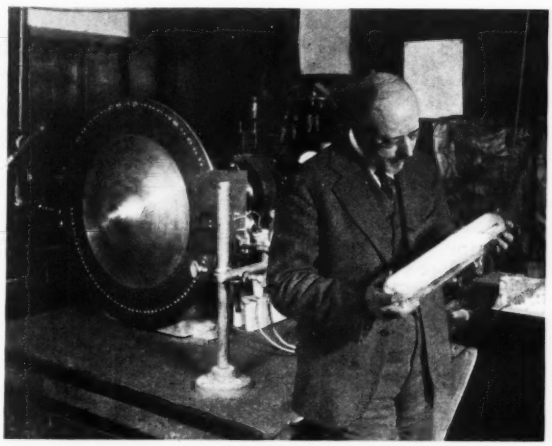
A LEGEND that has gained currency in modern German history books is dispelled by a letter which Sir Rennell Rodd publishes in *The Times* of 18th January. The Empress Frederick (then Crown Princess) was widely held responsible in May, 1887, for summoning the English specialist, Sir Morell Mackenzie, to consult before a serious operation was performed on her husband, whose death shortly afterwards has come to be attributed to his English wife's "distrust of German therapeutics." Sir Rennell Rodd was at the time a Secretary at the Berlin Embassy under Sir Edward Malet, and the papers of his former chief have now come into his hands. Among these he has discovered a letter written in 1887 to Count Bismarck, which states that a similar aspersion on the Crown Princess then published in a German newspaper "is doing her great injury and is devoid of truth."

Television in America.

By William J. Brittain.

The most serious rival of Mr. Baird, the British television inventor, appears to be among the three groups of investigators who are now working on the problem in America.

AMERICA, in her usual enterprising way, is making ready for television. Already a range of wave-lengths has been reserved, and several great wireless companies have announced that they are taking up research on television. Work of importance is being done by three groups; by the American Telephone and Telegraph Company, with Dr. Herbert E. Ives directing the research; by Dr. E. F.W. Alexanderson at the General Electric Company's laboratories at Schenectady; and by Mr. C. Francis Jenkins at Washington.



THE AMERICAN TELEPHONE CO.'S APPARATUS.
This process employs large photo-electric cells, which the director of research, Dr. Ives, is here seen holding. The perforated disc is used in transmission.

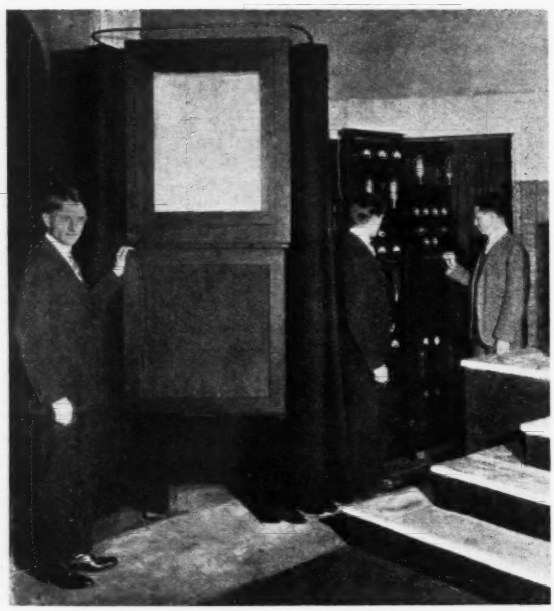
During my television tour of Europe (described in *Discovery* last September), I found that the continental investigators mentioned the United States chiefly when they talked of competition; and Mr. Baird told me recently that he considers the American Telephone and Telegraph Company his keenest rivals, this last-named concern having publicly demonstrated television. On a screen in New York people were able to see Mr. Herbert Hoover, Secretary of Commerce, who was two hundred and fifty miles away in Washington, speaking and turning over his papers; and they saw performers at Whippany, twenty miles away, giving an entertainment.

To scan the object to be transmitted a disc with fifty spirally arranged holes is rotated before a powerful source of light. Thus the object—in this case, the human face—was illuminated rapidly point by point as the light flashed in fifty consecutive beams across its surface. This system enabled light to be used that would be harmful if shown continuously over the whole of the face at the same intensity. Large photo-electric cells were grouped round the object, and as each point of the face was illuminated they sent out an electric signal corresponding in power to the light they received. Amplification by ordinary three-electrode valves intensified the signals to a strength sufficient for transmission.

There were two forms of receiving apparatus, a small one having a rotating disc similar to that at the transmitter, and running exactly in time with it. The disc revolved before a neon tube glowing brightly and dimly according to the currents from the transmitter, and projected on to a screen, two-and-a-half inches square, fifty strips of pink and black to make up the image of the face. The other receiver was far more complex. A long neon tube folded back and forth to make a grid four feet square had 2,500 wires connected to it, forming—with an inside coil—electrodes all along its length. The received current was distributed by a commutator to successive pairs of electrodes, the glowing portions of the tube at the electrodes making up the picture. So clear were the images on both receivers that when a man reading a magazine took his place before the transmitter, the larger pictures in the magazine could be seen on the receiving screens.

According to the company's experts, the apparatus demonstrated is quite suitable for television receivers to be attached to the telephone, so that the person called up can see who is speaking to him; while the large receiver makes it possible for an audience to see a speaker addressing them from a distance. Before outside scenes can be transmitted by television, however, there will have to be great improvements in the fineness of the structure, accuracy, and sensitiveness of the apparatus.

Dr. Alexanderson, at Schenectady, is working chiefly with his television "projector." He has a large



VIEW OF THE RECEIVING STATION.

At the Bell Telephone Laboratories the distant scene is made visible to the audience on the glass screen shown in the centre. Dr. Frank Gray, who is largely responsible for this method of receiving, stands at the left, his hand resting on another screen which contains a loud-speaker.

wheel round the periphery of which are twenty-four mirrors set at different angles. A spot of light directed by an optical system on the stationary wheel is reflected on to a screen in front. As the wheel is slowly revolved the next mirror catches the spot of light and sends it further along the screen. When the wheel is revolved quickly by electric motors coupled with it, the spot of light covers the screen in a zig-zag motion. By having a light fluctuating according to the currents received from a television transmitter, an image can be flashed on the screen. Dr. Alexanderson found, however, that the result with one light was not good. He therefore uses a cluster of seven spots of light, obtaining 49 times as much useful illumination. The screen is now lit seven times as brilliantly and the speed at which the light beam must zig-zag to obtain the same result is reduced to a seventh.

These are the mathematical gymnastics in which Dr. Alexanderson delights. By using a similar method of labour-saving he has made it possible for the high power telegraph stations of the Radio Corporation of America to work with 200 kilowatts instead of 2,000. He believes, indeed, that he is now approaching practical television. "For a reasonably enjoyable moving picture," he states, "there must be 300,000 flashes of light a second. By using seven beams of light instead of one, I need to make each beam of light give only a seventh of that number of impressions—about 43,000 a second. This speed is high, but only ten times the ordinary modulation speed which we use in radio, and therefore within reason." That is to say, by sending his signals over seven waves instead of over one he hopes to solve the problem. His method was demonstrated at a public meeting in New York on 13th January.

Mr. C. Francis Jenkins uses very effectively a prismatic disc for scanning the image to be tranmitted. The edge of the glass disc is ground as a prism, so that light passing through it when the disc is revolving is refracted back and forth, and can be made to zig-zag over a photo-electric cell or the receiving screen. So far he has produced shadows only, but it is stated that his apparatus needs no addition to its principle to attain light and shade television. If he had not been interrupted in his work by the American Government to develop weather chart apparatus for the navy, he says, he would already have provided television sets for the home. Mr. Jenkins has recently developed a lamp for his receiving apparatus, designed to overcome the great difficulty of finding a lamp that will change its light value rapidly enough with the fluctuations of the current from the transmitter. His new design is gas-filled and has seven individual light sources, which are operated together or in rapid succession by a rotary switch. This lamp may enable Mr. Jenkins to repeat the triumphs of his pioneer work in photo-telegraphy.

Researches in Noctovision.

PLANS have been developed since the new year to further the activities of the British Television Society, which was formed last summer at the Leeds meeting of the British Association. This was the occasion of a public demonstration of noctovision, when Mr. John Baird showed his "noctovisor," the latest development in television apparatus. Noctovision is one of the problems to be studied by the new Society, which exists "to afford a common meeting ground for professional and other workers interested in current research relating to television, noctovision, phonovision, telephotography, and allied subjects." The chairman is Dr. Clarence Tierney, and the executive committee, with Mr. J. Denton as honorary secretary, includes Colonel Yelf and Mr. W. G. W. Mitchell. Meetings are being arranged for London, Glasgow, Dublin, Manchester, Birmingham, Newcastle, Leeds, and Oxford, and a journal for the Society has been finally decided upon. Particulars will shortly be issued of regular meetings which are to be held on

the first Tuesday of the month at The Engineer's Club, Coventry Street, London.

In addition to noctovision, another interesting problem under investigation is phonovision, which opens up the possibility of storing pictorial records of people and events that may be " played " in similar fashion to gramophone records. This development was touched upon by Mr. Baird in a recent article in an American journal, *Popular Radio*, in which he stated that if the output currents of the light-sensitive cell are listened to in a telephone receiver, they are heard as sounds, every object or scene having its own peculiar characteristic sound. For example, the fingers of a hand held in front of the transmitter will give rise to a sound similar to the grating of a very coarse file, while the human face will cause a high-pitched whistle, which will vary in pitch as the head is turned or even when the features are moved.

" I have had a few phonograph records made," he writes, " of the ' sounds ' made by the faces of different persons ; by listening carefully to the reproductions of these records it is possible to distinguish between one face and another by the sounds they make ! With practice, faces may even be recognized by the sounds produced. A further interesting point is that these records may be turned back into images by making them vary the current at the receiver, so that we can now store a living scene in the form of a phonograph record as well as in the form of a cinematograph film. There is room here for the imaginative to indulge in speculation on the scope for future development along these lines."

Dealing next with noctovision, which he describes as " perhaps the most spectacular development of all in connexion with television," Mr. Baird recalls how in the first demonstrations of television it was necessary to use an intensely brilliant illumination, which caused the sitters considerable discomfort. He was told that even a vaudeville star would shrink from such an intense spot-light. While working on reducing the light necessary, the idea occurred of dispensing with light altogether and using rays outside the visible spectrum.

First of all experiments were made with ultra-violet rays, but these proved troublesome, so the infra-red rays of the other end of the spectrum were tried. By means of these it was ultimately found practicable to dispense altogether with visible light, with the remarkable result that it was possible to see in total darkness. The sitter goes into the transmitting studio and is immediately enveloped in complete darkness. Literally, he cannot see his hand in front of his face, but his friends at the receiving end are able to see him put his hand up in an effort to see it.

TESTING THE NOCTOVISOR.
Mr. Baird (right) is here seen testing the new apparatus on the roof of his London laboratories. With its aid vision is possible in complete darkness

" It is unwise to prophesy what may be the full extent of the importance of this development in warfare," Mr. Baird concludes. " It may even render it possible to follow the movements of an enemy when he believes himself to be under cover of darkness. Darkness, the great cloak for military operations, will no longer give so much security.

" It is to be hoped, however, that other uses may be found in peace time for this latest development of television. The fact that infra-red rays possess great fog-penetrating powers opens up possibilities for their use in connexion with commercial navigation.

" These invisible rays are employed in exactly the same way as ordinary visible light. That is to say, the rays are allowed to shine on the sitter, and the ' light ' reflected from his face is passed on to the infra-red ' televisor.' As to the distance over which television impulses may be transmitted, any circuit which will transmit clear speech is suitable. That being so, and as we now have direct telephonic communications between London and New York by a combined wire and wireless link, we may, perhaps, look forward with confidence to the day when New Yorkers will be able to see what is going on over 3,000 miles away in the great British metropolis."

Mary Stuart and the Confessions of Paris.

By C. Ainsworth Mitchell, M.A., F.I.C.

A new examination of documents in which a servant named Paris confessed details implicating Mary Stuart in the murder of Darnley, suggests that their admission as evidence was not justifiable. Her "guilt" is rendered definitely uncertain by this fresh light on the problem.

MARY, Queen of Scots, has been judged guilty of complicity in the murder of her husband largely on evidence drawn from the notorious "Casket Letters," supplemented by the depositions of those who had been executed for their share in the murder. As explained in a previous article,* the "Casket Letters" were produced before the English Commission appointed to inquire into the Queen's affairs. These documents purported to afford written proof that, prior to the death of Darnley, Mary had not only been in love with Bothwell but had also signed an agreement to marry him; and further, that she had written letters to him clearly indicating that she loathed her husband and was privy to a plan to murder him.

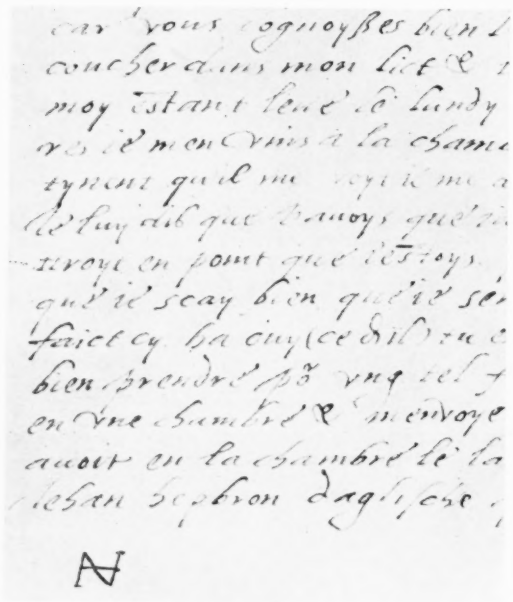


FIG. 1.
PART OF THE SUPPRESSED CONFESSION.
The initials "N. H." (N crossed by a stroke) seen in this portion suggest that Hubert was unable to write, but they express his consent to the document.

Among the depositions advanced in support of these letters was one of Nicholas Hubert, more commonly known as French Paris, or simply as Paris. The details given in this confession of the actions of the Queen and Bothwell are so circumstantial that they have convinced many who have hesitated to accept the letters as genuine. If, however, the confession itself cannot be accepted as valid evidence, it must also tend to discredit the letters, since the documentary evidence in any case must form a consistent whole.

Paris, as his name suggests, was a Frenchman who, for some years prior to 1567, had been in Bothwell's service, and shortly before the murder of Darnley had become a confidential upper servant (chamber child) in the household of the Queen. One of his duties was to carry the Queen's private letters to her secretary and others, and his name appears prominently in the "Casket Letters" as one of the messengers whom she is sending to Bothwell. In the so-called "Cecil's Diary of Events," which was produced before the English Commissioners, there are several allusions to Paris, the most significant of which (here rendered into modern spelling) are the following:—

February 5. "She lodged all night under the King in the chamber wherein the powder was laid thereafter, and whereof Paris her chamber-child received the key."

9. "She and Bothwell supped at the banquet with the Bishop of the Isles, and after passed up, accompanied with Argyle, Huntly and Bothwell, to the King's chamber, and there they remained cherishing him, while Bothwell and his (ac)complices had put all things to order, and Paris his chamber-child had received in her chamber the powder, and came up again and gave the sign. And they departed to Bastien's banquet and masque, about eleven hours, and thereafter they both returned to the Abbey, and talked till twelve hours and after."

10. "Betwixt two and three of the clock the King was blown in the air by the powder."

After Mary's defeat at Langside and her flight to England and Bothwell's escape to Scandinavia, French Paris and several of Bothwell's servants who were believed to be implicated in the murder of Darnley were arrested, and having been forced to confess their guilt were executed. On some of their confessions appear to have been based these statements in "Cecil's Diary."

* "The Spurious Marriage Contract of Mary Stuart." C. Ainsworth Mitchell. *Discovery*, Vol. VI, p. 199.

Two separate confessions of Paris are extant, one made on 9th August, 1569, and the other the following day, and it was the later one only that was sent to England to be produced if additional proof of the Queen's guilt was required (Goodall,* II, 88). It is not difficult to discover a reason for the suppression of the first confession, for it tends to implicate Maitland, who came to England as one of the Queen's accusers, as one of the prime instigators of the murder, and its evidence would therefore have been more comprehensive than was wanted. This confession, however, is as worthy of credence as the second one, for both are attested similarly and they must stand or fall together. Both confessions were made in French, and the original of the suppressed document is still to be seen in the British Museum.

Like its companion, it was drawn up at St. Andrews. It bears no signature, but is initialled on four of its pages with the letter N crossed by a stroke (*i.e.*, N. H.), and from this it may be inferred that Paris was unable to write (see Fig. 1). The confessions were read over to him, however, and he signified his assent to what was read. This document was first published in the eighteenth century by Calderwood in the form of a translation which was reprinted by Goodall (I, 137). It opens with a conversation between Bothwell and Paris in a nook between two doors in the Queen's chamber at Kirk o' Field, and tells how Bothwell said that "among us we have decided to blow him (*i.e.*, Darnley) up with powder in the house." Paris remonstrates and says that it will bring trouble on them all, but Bothwell silences him with the remark

The Preists Entrance
The Bell
The Place of Marriage
The House in which the King was kept after the Murder
The Orchard
ye Kirk of Field Kirk yard

FIG. 2.
CONTEMPORARY SKETCH OF THE MURDER OF DARNLEY.
This illustrates the theory commonly held at the time that Darnley's house was "completely wrecked" by a mine, which could hardly have been caused by the explosion of a "heap of powder" mentioned in Paris's confession.

that he has the support of Argyle, Huntley, Morton, Ruthven and Lindsay, and especially of Maitland of Lethington, "one of the best ingines or spirits of his country, who is the enterpriser of all this thing." Paris then proceeds to eulogise Murray,† and asks how he will receive it, to which Bothwell replies that Murray will neither hinder nor help in the matter.

In the second part of the confession Paris describes how on the following Sunday, against his will, he had admitted to the Queen's chamber John Hay and John Hepburn, who had brought the powder and laid it down in the midst of the chamber, how the Queen had gone to the wedding festivity of her servant Sebastian, while Bothwell, Hay, Hepburn and Paris himself waited in a nook in the King's garden when "a great thunder

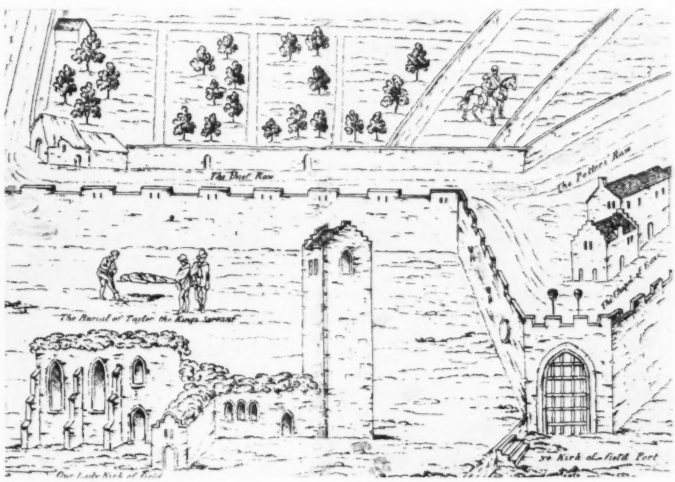


FIG. 3.
ANOTHER PART OF THE CONTEMPORARY VIEW OF KIRK O' FIELD.
In this sketch the positions of the buildings have apparently been reversed as in a negative.

* See Bibliography at conclusion.

† The Earl of Murray (Moray), the Queen's half-brother, who, as Regent of Scotland, was the chief Scottish Commissioner at the Westminster Conference. (*cf. Discovery*, Vol. VI, p. 200.)

clap like a tempest rose up." All fled away to Bothwell's chamber in the Abbey, where Bothwell told them that the crime lay not to their charge but to the Lords of the country, who with him had committed it.

The Second Document.

According to Anderson the original of the second confession is in the Record Office, and a contemporary copy, endorsed by Cecil, is in the British Museum. This document is in narrative form, interspersed with interrogations and replies, and the evidence it provides is very telling. It describes how Paris had travelled with the Queen to Glasgow, after leaving Bothwell at Callander, and how after two days in Glasgow he had been sent with letters to Maitland (the Queen's secretary) and Bothwell in Edinburgh, and had returned to Glasgow on the afternoon of the next day, and delivered the replies to the Queen. From the point of view of confirmatory evidence of the letters these are the most important passages of the confession, the later portion of which gives particulars of the murder of Darnley, but omits the compromising reference to Maitland of Lethington, Morton, and the other lords.

Before considering the bearing of this confession on the subject matter of the letters, it is necessary to deal with a discrepancy between the first and second letters themselves. The Scottish nobles assert in their diary of events (Anderson, II, 269), that Mary arrived in Glasgow on Thursday, 23rd January, and that on Monday, 27th January, she left Glasgow and brought Darnley to Callander on the return journey to Edinburgh.

If the internal evidence of the first letter is to be accepted, it was thus begun on Friday, 24th January, and was not finished until late on Saturday, and hence could not have been sent off by Paris until Sunday morning, 26th January. But the second letter which, according to its own statement, was not sent off until Saturday morning, 25th January, expresses the writer's disappointment that Paris (who did not leave Glasgow with the first letter until the following day) had not yet returned with an answer to the letter which had not yet been sent.

It has recently been asserted (*History*, 1927, XII, 45, p. 42), that " the bottom has been knocked out of this argument " by modern controversialists. The explanation put forward (*e.g.*, by Henderson and by Lang) to explain away this fatal time discrepancy is that the chronological order of Letters I and II was reversed, either by accident or with the idea of first showing the Queen's disposition towards her husband before putting forward the most damning letter of the series.

But even if Letters I and II were reversed, there still remains the evidence of the Scottish lords in " Cecil's Diary " and the evidence of the confession of Paris to be squared before the times will fit. Both Lang and Henderson are precise on this point. Lang says :—" If the Lords are right in declaring in ' Cecil's Journal ' that Mary left Edinburgh on 21st January, 1567, and arrived in Glasgow on 23rd January, then the evidence of the letter is incompatible with that of Paris, and one or both testimonies must go."

Henderson (" The Casket Letters," p. 88) is equally aware of the fatal character of the discrepancy, for he says :—" Certain statements of French Paris would indicate that the letter was dispatched on the 24th, but it has been objected that his confession was obtained in a suspicious manner, and is insufficiently attested. In any case his statements cannot be accepted as unimpeachable, and therefore may be left out of consideration, especially as his confession was made subsequent to the Westminster Conference."

Conflicting Evidence.

The audacity of the conclusion is amusing. A certain document is put forward by the Scottish lords as confirming part of their evidence against the Queen, but only to be produced if essential to their credit ; it contains statements which cannot be reconciled with those of other integral parts of the documentary evidence, even after they have been transposed to reconcile their own difficulties, and therefore may be " left out of consideration." Historians will be glad to know of this easy way of " knocking the bottom out of an argument." There are also some curious discrepancies between the accounts of the murder as given by Paris and in other contemporary statements. According to this confession, the powder was merely laid on the floor of the Queen's chamber, which is difficult to reconcile with the statement that Darnley's house was blown up " with such force and vehemence that of the whole lodging, walls and others, there was nothing left unruined and reduced to dross to the very ground stone."

It was commonly believed at the time, and this is borne out by the contemporary sketch (Fig. 2), that the house was completely wrecked by a mine laid in the foundation, as Buchanan asserts in his " Actio," which would hardly have been the result of the explosion of a heap of powder laid on the floor of a room. Again, if the statement of Paris is correct (and Buchanan tells the same story in his " Detection "), Darnley was killed by the explosion, but if we are to accept

another statement by Buchanan (*History*, p. 215), the murderers, in three gangs, one of which was headed by Bothwell, silently stole into the house, opening the door with false keys, strangled Darnley and his servant Taylor, and carried their bodies into an adjacent garden (*c.f.*, Fig. 3), after which the house was blown up "from the very foundations." The strangling story was commonly accepted at the time, and is cited by Sir James Melville (Memoirs, p. 86,) who says that "Bothwell . . . had before laid a train of powder under the house where the King did lodge, and in the night did blow up the said house with the powder; but it was spoken that the King was taken forth and brought down to a stable where a napkin was stopped in his mouth, and he therewith suffocated."

Motives of Prudence.

It is impossible now to determine which of the contradictory versions given by Buchanan is true, or to decide whether more weight should be attached to the confessions attributed to Paris, than to the conflicting statements of one of the principal accusers of the Queen before the English Commissioners. It was probably from motives of prudence that the first confession of Paris was suppressed, and for the sake of consistency in their documentary evidence Mary's accusers would have done well to suppress the second one, too.

My examination of these remarkable documents strengthens the conclusion to which I came from an examination of the "Casket Letters," namely, that they show irreconcilable discrepancies and that their admission as evidence was therefore not justifiable. Fairness to an accused person has always been an axiom of English justice, but to condemn Mary, Queen of Scots, on the evidence of contradictory documents, which she was not allowed to see, was the negation of fairness. The canons of what is fair in human dealings do not change with the lapse of time, and a course of action which would not for a moment be tolerated in the twentieth century cannot be justified now because it happened to take place in the sixteenth century.

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Fuel Research Notes.

Investigations on coal are at present proceeding along three main lines. The first is the treatment of coal with hydrogen under high pressure, to produce motor spirit and fuel oil. This method gives a higher yield of oil than any other method so far applied to coal, but it is costly in the initial plant and requires cheap hydrogen, and it cannot be stated to be commercially established as yet. The second method is the conversion of coal into gases, some of which are then caused to interact for the production of liquid fuels. The third method—to which special attention has been given for a long time in this country—is the low temperature carbonization of coal, that is, the treatment of coal by heat away from the air at temperatures varying from 400 to 600° C. below the temperatures at which gas works operate in the manufacture of coal gas. Over two hundred processes to deal with coal in this manner have been described. One can only wonder at the fertility of invention manifested, based on and inspired by the belief that the problem is solvable and worth solving.

The Fuel Research Board and a number of public and private organizations are actively engaged in testing out a number of these processes on the industrial scale. The result aimed at in varying degrees by all these processes is the production of a readily ignitible fuel which will burn without smoke; of a liquid product known as primary tar, quite different physically and chemically from ordinary tar, and of a rich gas of high calorific value capable of special uses. The smokeless fuel, apart from its obvious domestic use, is finding new outlets because of its homogeneous nature and the ease with which, as a result, its combustion may be regulated. Chief among these is the direct feeding of the hot and reactive fuel on to the chain grates of tube boilers leading to a considerably increased efficiency. The use of this fuel, whether in pieces or pulverized, is already proving of the greatest interest to electricity generating stations. Our knowledge of primary tar is not great, but is growing, and this material may well prove to be a rich source of new raw materials. We observe, for example, that it is claimed to contain isoprene, which is one of the more promising starting points for the manufacture of synthetic rubber. Apart from this it can be made to yield motor spirit and valuable fuel and lubricating oils. In conclusion, it may be said that the commercial realization of this method of treating coal has been brought appreciably nearer by recent research.

The World in the Home.

By Edward Liveing, M.A.

Manchester Station Director, British Broadcasting Corporation.

Appropriately the author has left for the last article in this series a subject which presents perhaps the most important aspect of broadcasting. The international possibilities of this new medium are unbounded.

"WHEN the house is built, Death enters in"—so run the words of an old Spanish proverb. In the series of articles which is concluded* in this number of *Discovery*, I have endeavoured to weigh the significance of broadcasting as a force permeating our social life. I have set about my task with a very definite object in mind. Broadcasting is an institution that has been built rapidly, and there are still sceptics among us who regard it as a house built upon sand and not upon rock. Its novelty, its pristine wonderment as an invention are wearing off, they would say, and it is already a moribund achievement. Yet another school of critics has always maintained the intellectually superficial point of view that broadcasting should be employed solely for amusement and entertainment.

A Mental Stimulant.

Why is it, then, that not only are new listeners recruited in all parts of the world day by day, but also that nearly all those listeners, who have installed and used reception apparatus for several years past, are continuing to use it? I think the reason is this. When the listener's initial and rather feverish excitement, which leads him to turn on his wireless set every night of the week, dies away, he begins to use his discrimination with regard to programmes, and he finds himself selecting beforehand those particular items—symphony concerts, speeches, news bulletins, special talks, whatever they may be, that especially attract his interests. He is, in other words, no longer employing broadcasting as a drug to his senses, but as an active stimulant to his mind. This is the process experienced by the majority of intelligent individuals, and it is this which is destined to make of broadcasting a social force of the first magnitude. As with the individual in marriage, to which our Spanish proverb refers, so with a new invention. The early brightness of achievement dies away as the invention becomes an institution, and is fused into the common stock of our civilization. But its power, less superficially displayed, becomes, in its very fusion with the things of life, deeper and more vigorous, lending help to the old and impulse to the new.

It is broadcasting as a factor in internationalism that we may well review in this last article. The advance of scientific knowledge leads us to-day to apply the word "change" rather than "progressive evolution" to the fluctuations of human civilization, but it may safely be suggested for general purposes that the welter and chaos of the era through which we are passing may be described as the adolescence of the race taking place after thousands of years, and maturing at a speed which entails acute conflict and struggle between the different members of the body. This surely is not disintegration, but the inevitable conflict experienced in general union. Behind all the apparent strife a vast glandular system of new ideas and impulses is working. In every stage of civilization new means of expression play their part in the consolidation of such impulses. The ether knows no boundaries, and I think that future historians, in recording the story of this century, will agree that broadcasting was the most potent agent in the cause of international peace through its propagation of international culture and languages.

New Developments.

To-day listeners may turn on their sets and listen perhaps to a talk on the French language which is being heard by their fellow-listeners in Germany, or to an American revue in a London studio. Listening to European stations has become quite a commonplace affair to users of powerful valve-sets, and a growing number of enthusiasts reach out for programmes from the United States and Canada.

The use of powerful valve-sets is, however, denied to the majority of listeners, and it is into the homes of the majority that the broadcaster has the task of introducing the world. Fortunately ways and means are not wanting and are being rapidly developed and utilized. The telephone cable system of European countries is being greatly improved and modernized, and will eventually be suitable for the establishment of a European simultaneous broadcast system, such as those arranged already in Great Britain, Germany,

* Next month the author hopes to reply to the criticisms which have been published from several correspondents.

and Spain, by means of which the stations in the large cities are linked up with one another and can exchange programmes. A notable instance of the use of "wired wireless" was the relay to British stations of the opening ceremony of the Menin Gate Memorial last summer, the ceremony being relayed by land-line through Brussels direct to London.

Imperial Broadcasting.

With the development of broadcast reception, however, and the establishment of high-power stations we have the alternative to "wired wireless" of programmes radiated from a station of one nationality, picked up on powerful receiving sets by other nationalities, and rebroadcast through the stations of those nationalities. Thus a Glasgow station of the future might transmit a Scottish programme to Europe one night and receive the next, in common with other stations, a Castilian programme from Madrid. The B.B.C. has a special receiving station at Keston in Kent, which is being increasingly used for picking up programmes from the Continent, the United States, and the Empire, and relaying them through its chain of stations, while it has instituted a new short-wave station in 1927 for Imperial broadcasting. Nearly all the outstanding international ceremonies are now available to users of simple sets in many countries—speeches from the League of Nations assemblies at Geneva, the speech by the Prince of Wales at the opening of the Peace Bridge between Canada and the United States, and the retransmission in the United States and the British Empire of a portion of the 1927 Armistice Day programmes transmitted from London, being a few instances readily called to mind.

Ways and means are not wanting; they are being developed and will gradually be perfected. But many problems, quite apart from the technical ones, in this broadcasting exchange confront us. First and foremost is that of the language barrier. It may be said truly enough that broadcasting is already doing much to remove the barrier by language talks. Future generations, learning two or more languages in better ways and with more extensive facilities than existed in our youth, will have no difficulties with foreign programmes, two or three languages perhaps being used as the standard international broadcasting media for programme announcements. Meanwhile an interesting evolution is taking place in the languages of most nations in that the voices of wireless announcers are creating and maintaining a new cultural standard for the spoken word. This development certainly should make an international exchange of programmes easier to the listener, no matter whether the programme emanates from Rome or from London.

The announcing of programme items in two or more languages is admittedly a cumbersome method; in any event the method is inapplicable to plays, opera, and the majority of talks. The rival claims of English, French, Spanish and German as international languages have been put forward in so many different books and articles that I do not propose with my inadequate knowledge to add to the controversies that have been created. It is conceivable that Esperanto or some other artificial language may be largely used. Lessons in Esperanto are already broadcast by stations belonging to the German organization. It is even conceivable that in the course of many years an international language will be evolved with the support of a central broadcasting board set up to deal with the linguistic problem.

Meanwhile, much valuable and unostentatious work is being done, through the various national broadcasting organizations, for the consolidation of international friendship and sympathies. Foreign novelists, foreign singers, modern foreign composers and conductors, frequently appear before the microphones of stations in this country. Most stations to-day transmit talks on foreign travel.

A Poet's Prophesy.

In taking hold of the air as we have done, we have brought the home into the world and the world into the home. Shelley likened life to "a dome of many-coloured glass." To this dome broadcasting holds its mirror, but has not yet reflected more than a few of its facets. It has come into our midst to play a great part in the expression of national and international culture. Broadcasting knows no such things as frontiers or boundaries. There is a prophetic note in some lines from a British poet's ode on "The Spirit of the Spheres," written long before broadcasting was even imagined as a possibility, but which may well be quoted at the end of our survey of this new social force:—

. . Thou art light and thou art free,
And to live rejoiceth thee,
Where the splendours greatest be. . .

Thou a seraph art to go
All undaunted to and fro
Where the finest ardours glow. . .

Thou an angel art, and well
It sufficeth thee to dwell
In the smallest creature's cell. . .

Thou a spirit art most sweet,
And to make all life complete
Everywhere thou hast thy seat.

Winter on an Arctic Island.

By Christian Leden.

The following are some typical pages from the diary of the author, a Norwegian explorer who has lately spent several years among the Eskimos in Arctic America. The photographs are of scenes selected from a cinema film which he has prepared, while a book on his experiences has been published on the continent.

THE October storms are raging and breaking up the ice as quickly as it freezes. As long as this weather continues I am kept a prisoner on a desolate island north of the Hudson Bay. Besides myself the island has four other inhabitants—three Arctic rabbits and "Nannok," a half-grown dog who keeps me company. I call him "Nannok" because his head is like that of a polar bear, and the Eskimos call the polar bear Nannok. On a small island nearby live a couple of Eskimo families who, like myself, are waiting for the ice to freeze, so that they can cross to the mainland with their sleighs. They want to go west, hunting wild reindeer, and I will go south to visit the "*Karnermiut*" and other island tribes. Officially my Eskimo neighbours live from seal hunting, but actually they are now living upon old rotten walrus flesh, originally intended for dog food. Until the ice is frozen it is hopeless to look for seals.

THE AUTHOR IN ESKIMO COSTUME.

My own rations are very low indeed. I have about twenty pounds of rolled oats, a little tea and sugar, a few hard biscuits bought long ago from a fur-trading station in the south, a small case of dried vegetables—and fifty cartridges for rifle ammunition. This is all that is left of the provisions rescued two years ago from a shipwreck. Everything else that was saved then is now about 150 kilometres south from here, on the south coast of Chesterfield Inlet. Because I have so little food I have decided that it is wisest to live alone. At ebb tide the island on which the Eskimos live becomes a sort of peninsula attached to my island, so they can visit me by springing from rock to rock. Thus I regularly have daily visits from them. If the Eskimos crowded into my tent at every meal time I would not have the heart to refrain from sharing with them, and then none of us would have enough. I have therefore accustomed myself to cook and eat only at flood tide. Perhaps this may seem cruel and selfish, but with the Eskimos as table guests my provender would vanish in two or three days, whereas it will last me for six or eight weeks when I take my meals alone—until the sea is frozen and I can make my way down to Chesterfield.

This long tedious period of waiting for the ice to become solid I utilize to develop the films which I have taken during the last two years. I have to do this at night, for my snow house cannot be darkened during the day sufficiently for my purpose. I begin this work immediately after my evening meal and work ordinarily until about six in the morning. Then I sleep awhile until the next flood tide, when I prepare my breakfast and lunch. For practical reasons I find it best to combine these meals. Sometimes I sleep too long, and thus save both breakfast and lunch. Then I prepare my supper and begin again with the

ESKIMO WOMAN (RIGHT) AND HER SON.

During the unsettled period, before the ice was frozen solid, the author's Eskimo neighbours were unable to hunt seals and lived on walrus flesh.

THE DOG "NANNOK."

films. Now and then while I am sleeping my lamp goes on strike. Then the hut becomes so cold that the films freeze dry, which is not the best way of drying films. However, I managed to save about 2,000 feet of film. When this work is done I have nothing to do but listen to the melancholy music of the storm and to be on guard against the polar bears. Through the developing of my films I have become accustomed to waking all night and cannot sleep. Often my thoughts wander to my friends and relatives in the civilized world, with whom I have had no communication for a long, long time. I see them before me again, and remember the happy hours we spent together.

* * *

At last the ice begins to freeze and the polar bears are less troublesome. They have enough to do, sitting by the seals' airing holes in the ice and waiting for *Pusi*, the seal, to come there to breathe. Some time ago when I returned from a hunting trip, I found my snow house completely ruined. The Eskimos on the neighbouring island told me that they had seen three white fellows paying me a visit. Apparently they were so annoyed at not finding me at home that they smashed my house. As all the men from the Eskimo camp were absent hunting there was no one to take vengeance on the rascals. Women do not as a rule fight with such as my visitors, who were polar bears.

A GIANT POLAR BEAR.
The size can be judged by comparing the carcass with the dog standing over it.

THE OCTOBER STORMS.

* * *

Although it is now November, the ice is still so thin and unsafe that it is difficult for us to hunt seals. The bears, however, are busy. They have no dread of breaking through the ice. Recently we saw two of them at work and followed them, but they kept nicely out of range of our guns. They preferred such thin ice that we could not get near to them. The ice on the sea will carry a bear when it would not carry a man. In walking a bear distributes his weight on four great flat feet, scarcely lifting them, but sliding along somewhat like a human being on skis; whereas a man puts all his weight on one leg at a time (for an instant). It is useless to compete with bears in hunting seals, and as the bears themselves also are too clever to let themselves be caught, we shall soon have little or nothing to eat.

This hard climate makes it essential that a human being has some flesh for meat and also some fat. It is impossible to live on oatmeal and biscuits when winter begins in earnest. But I cannot bring myself to the point of eating the foul-smelling walrus flesh intended for dog-food, and, however I may regret it, I must see if I cannot manage to bring the rabbit triplets to my cooking-pot. I have decided that

ESKIMO SNOW HOUSE.
The author was marooned and while waiting for the winter's freeze to set in lived in a snow house. The stick seen against the wall is about six feet in length.

these rabbits are brothers, and that they must have been born on this island. At intervals of a few days I use a cartridge for each of the three rabbits. I cook them whole and gnaw at their poor thin bones as long as anything remains thereon, then my friend "Nannok" gets them to exercise his chewing muscles and his puppy teeth. Thus the rabbits also are released from their dreary existence on this island.

My dog friend and comrade has as yet experienced no hunger. He has no objections to the ancient and odorous walrus flesh and eats his belly full daily. I have learned to love this beautiful intelligent animal, and it will be difficult to part with him when I go south, at the end of November. "Nannok" is still too young to be used as a sleigh dog, and I must leave him for the present with an Eskimo friend. I have promised the Eskimo that he shall have the dog when I go to "*Kabluna Nonnani*" (the land of the white people), but upon the condition that "Nannok" shall be particularly well cared for and kindly treated. Poor "Nannok"! He makes a terrible fuss when I leave. He has to be tied to prevent him from following me. I hear his plaintive howls far out on the field ice and I am on the point of returning. But I pull myself together and go on. The longer I keep the true-hearted beast, the harder will it be to part with it—and I cannot take him back with me to the civilized world. . . .

The Marsh Warbler's Mimicry.

By E. W. Hendy.

Whether the mimicry of the marsh warbler is conscious or instinctive is a problem that has yet to be solved, but the "sweet, silvery individuality" of its song makes it an unmistakable bird for observation.

To many who love birds the marsh warbler is something of a mystery, for it is sparsely distributed, and it is only in comparatively recent times that it has been recognized as a British-breeding species. Whether this is due to its having been overlooked, through its close resemblance to the reed-warbler, or to its having extended its breeding range, is a matter upon which there is some difference of opinion. And as its principal haunts are in the southern counties it is little known to naturalists who live in the North of England. It has only once been known to breed in Cheshire.

There is a tract of flat, low-lying country which, within historical times, was an impenetrable marsh formed partly by the undrained overflow of sluggish rivers, and partly by the salt influx of the sea. Even to-day the land is only a few feet above sea-level, and the flora is partly maritime. In a wet winter it is still inundated, though no longer by salt water, for weeks and even months together. The bones of pelican, cormorant, puffin, whooper swan, sea eagle, kite and crane, dug up by industrious antiquarians from its peat beds, give some indication of the profusion of its bird life in the past. The bittern, indeed, still occurs, but meets its usual fate at the hands of the ignorant gunner or selfish collector. To-day, it is a vast expanse, half wild, half tame, of rough meadow, pasture and osier beds, sweeping to a line of hills which rise scarcely to a couple of hundred feet.

It is the osier beds that the marsh warbler loves, and of these he usually chooses the taller ones, growing to a height of eight to ten feet. There are no hedges, but in their place are broad ditches, or rhines, which effectually frustrate the trespasser, unless he is furnished with a jumping pole or plank. The thickness of the osiers renders them impenetrable to sight, but the listener on their margin soon becomes aware of their bird inhabitants. A guttural, squeaky chatter rises from the herbage at the side of a rhine, and soon a sedge-warbler, with white eye-streak, and back striated in various shades of brown, appears, with "curses not loud but deep." Then, from amid the dense depths of the osier bed, comes a song, whose confused, husky burbling is relieved occasionally by piping notes, pitched higher, as though the singer were trying in vain to attain to loftier and more tuneful flights of expression. This is the reed-warbler. And then there breaks in upon this strident babel of banderlog talk, a song whose quality at once arrests and delights. Though its mode is that of the reed and sedge birds, there is in it a clear, liquid quality which at once distinguishes it from their gruff tones. It is the marsh warbler.

Its "sweet, silvery individuality," as Warde Fowler wrote of the song, makes it unmistakable. Marvellous impersonator though this little bird is, it is not a mere mimic. *Nihil quod tetigit non ornavit.* It refines. The hysterics of a blackbird, who thinks he has seen a ghost, are toned down when the marsh-warbler imitates them. The lapwing's peevish call when the young are about becomes even more plaintive, "more

condoling," as Bottom the weaver would say. To suggest that it is possible to improve the song of the nightingale or skylark would seem perilously near exaggeration, but at the risk of being dubbed too imaginative I will say that to me this warbler seems to reproduce them with a lighter touch.

If curiosity spurs the listener to try to obtain a glimpse of this mysterious and intriguing songster, he will soon find it a difficult task, for the depths of an osier bed are as dense as the jungle. Crouched among its undergrowth, he finds sunshine has become twilight; peeping along the rows he will catch sight for a few seconds only of a small brown bird with fawn coloured breast, and, if he is lucky, may identify the lighter shade of the legs which is one of the marks which distinguish the marsh from the reed-warbler. But, in the field, to separate the two, except by their voice, is almost impossible.

Heard at close quarters, the differences between the songs of marsh and reed-warbler are even clearer. The reed's monotonous reiteration becomes almost tiresome; but the marsh's lively performance is full of surprises; he keeps you wondering what he will do next. Upon the sibilant small talk of the osier leaves (for they chatter where pines whisper) suddenly bursts, almost at one's elbow, the scold of a blackbird; look round cautiously, and you will marvel to see that it proceeds from the throat of a mouse of a bird less than half the other's size. And there follows, from the same source, a bewildering medley of lyrical mimicry—the whitethroat's chuckle, the skylark's "silver chain of sound," the chirp of quarrelsome sparrows, the twittering of swallows in the eaves, goldfinches' glittering links of melody, the willow-warbler strain which "has a dying fall," the chaffinch's call notes, the blue tit's scold, the starling's bubblings-over, and a dozen other songs which follow each other too quickly for identification. The blackbird's inconsequential musings were once imitated so perfectly that they stirred him to emulation; he sang a stave himself, and it would be hard to say whose ballad was the more perfect.

Mimicry in bird song is a fascinating but difficult subject. Why do some birds imitate more than others? The sedge, as well as the marsh warbler, borrows from his neighbours, and so does the reed, though less successfully, and to a much smaller degree. The starling can parody almost any song (his gurgling sounds like lampoons, more than a little scurrilous; but he, at any rate, evidently enjoys them). And, again, is imitative song conscious or instinctive? Perhaps it is both, but the most honest answer is "we do not know." In the meantime we may be content to listen and enjoy.

World Airways of the Future.

By A. E. Blake.

Below is the conclusion of a survey of the world's airways. As in the previous article, which appeared in May 1927, the existing and projected routes are dealt with on a regional basis. The new line to India may be extended in the near future, when it is hoped to establish connexion with Australia.

THE Central European airway system, dealt with in the previous article, is characterized by a highly-developed area of operation and the comparative frequency of important industrial centres along its routes. Economic working thus takes the form of flying in short stages, often in competition with efficiently organized surface transport. There is little scope on the Continent for the flying boat or seaplane (except across the Baltic and to provide communication with the English Midlands) and in these conditions probably none at all for the airship. The Mediterranean, however, being intermediate between the Central European and Atlantic systems, provides ample opportunity for the employment of flying boats, and a limited scope for airships, owing to the comparatively short distances between stopping places.

The Atlantic system. On the other hand, the Atlantic is nothing but a highway, with few groups of islands which would justify or even allow a break in the long journey. The shortest crossing, between the Guinea Coast and Cape S. Roque, is over 1,500 miles in length. At a time when flying-boat construction appears to be enjoying an attention that compensates for many years of neglect, the possibility of the use of such craft on the shorter Atlantic crossings cannot be dismissed; but it seems probable that, for some time to come, their use will be restricted to expediting the carriage of mails and passengers by providing air services between intermediate island ports of call and the ultimate destination of the steamship. Its employment in this capacity has received the approval of the Argentine and French Governments, and a concession

has been granted to the Latécoère Company for the operation of a mail service from Toulouse to Cape Verde Islands (an extension of the existing line along the north-west African seaboard) and between Fernando Noronha Island and Buenos Aires, *via* Pernambuco and Rio de Janeiro. The mails will be trans-shipped to a steamer at each end of the long sea crossing, which should shorten the time taken to reach Buenos Aires to seven and a half days and, after experience has been gained, to four, when it is possible that the entire journey will be made by air.

By Airship to South America.

Many plans are being matured, however, for the inauguration of direct air communication between Europe and South America. One which, first advanced in 1920, has now reached the stage of obtaining an official concession from one of the interested Governments, is that of the Colon Compañia Transaerea, an enterprise in which German and Spanish interests are co-operating, and which has for its object the maintenance of a regular service from Seville to Buenos Aires.

A sea route of 6,000 miles in length is obviously one on which airships have an admirable opportunity of proving their utility, and it is proposed to use Zeppelin craft of 3,800,000 cubic feet capacity, with accommodation for forty passengers and ten tons of freight. The terms of the contract provide initially for the operation of a monthly return voyage and, later, a fortnightly service. The Colon Company undertake to institute the service not later than 1930, but it is understood that not only is it likely to be in full operation at an earlier date, but a preliminary voyage may take place this year. Extensive preparations will, of course, be necessary. After the payment to the operating company of slightly more than a million pounds by way of subsidy, the terminal airport to be constructed at Seville will become the property of the Spanish Government. The subsidy will be paid on results, with an annual maximum of about £200,000. The ground organization will include emergency mooring masts to be erected at intervals along the north-west African and South American coasts.

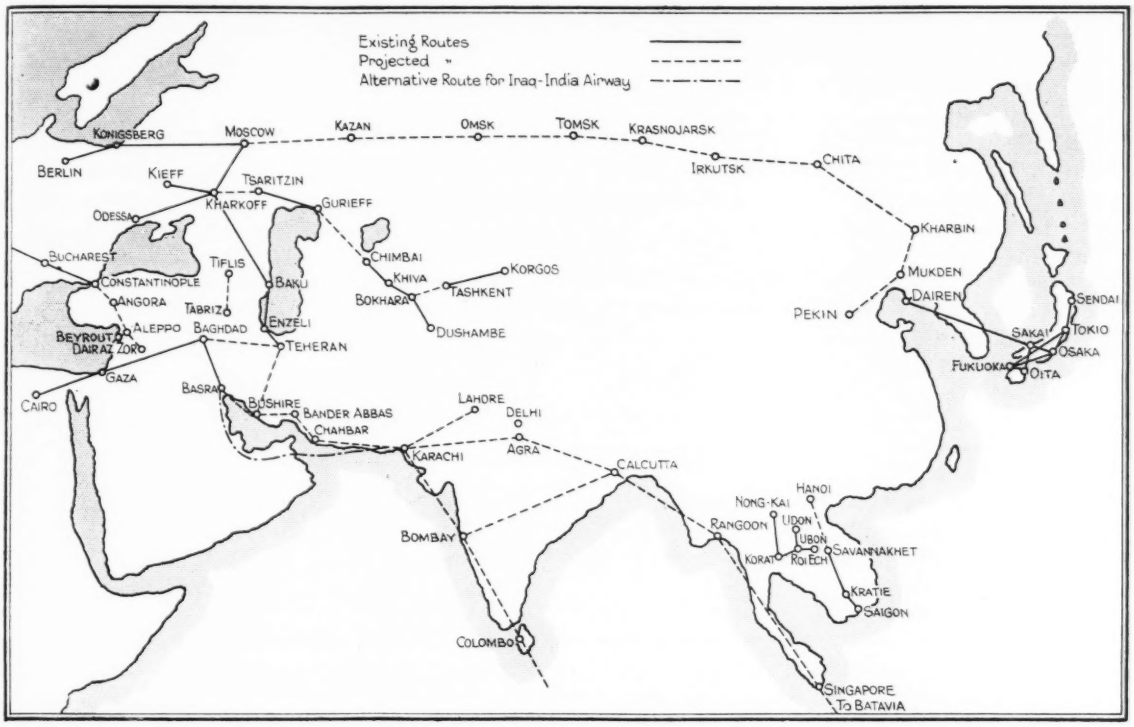
It is estimated that the time taken by the airship voyage will be less than five days, a saving of more than a fortnight in comparison with the time of the fastest steamship service. A subsidiary weekly service employing smaller airships capable of carrying sixteen passengers and a ton of frieght has also, under the Colon Company's concession, to be inaugurated between Seville and the Canary Islands.

The Asiatic system. Poorly served by existing means of communication, a continent of vast spaces, yet of dense populations and rapidly developing industrial activity, Asia should offer to air transport a field for exploitation as promising as any in the world. The Union of Socialist Soviet Republics was, until this year, the only power which had any substantial aerial achievements to its credit, but the disposition of such lines as Russia has instituted would appear to suggest a strategic rather than an economic objective. Kharkoff, which is connected to Moscow by an airway of nearly 500 miles in length, is evidently destined to be a centre of considerable importance in the air map of the Middle East. Lines radiate from this town to Kieff and Odessa in the west, while another, of 1,500 miles, runs to Baku and Enzeli, on the Caspian Sea. Dushambe, on the Afghanistan frontier, is to be the terminus of another line from Kharkoff, of which only the Tsaritzin-Gurief and Chimbai-Khiva-Bokhara-Dushambe stages are yet established. Tashkent and Korgos are also in aerial communication, and the extension of this line to Bokhara will bring the heart of Asia into touch with Moscow, and thence with Europe.

Of far greater importance from the commercial standpoint is the project sponsored by a subsidiary company of the Deutsche Lufthansa, the largest German concern, for an 8,000-mile airway across Asia to Pekin. This vast scheme has been the subject of a special two-months mission which flew the whole distance and has made its report. If the provision of such an extensive system of ground organization as would be necessary does not prove prohibitive, the benefits of such a service offer every inducement for its inauguration. Seventeen days are taken on the railway journey from Berlin to Pekin and, flying only by day, an aeroplane could accomplish the flight in five. The promoters seem very sanguine of success and have named 1929 as the year of the service's commencement.

The England—Australia Project.

By that time, it may be hoped, the British service across southern Asia to Australia will then be in full operation, although it has received a temporary check from the refusal of the Persian Government to ratify the agreement permitting regular operation of foreign aircraft along the eastern coast of the Gulf. The Indian Government has accepted in principle the recommendations of the Air Board that a vigorous development of Indian civil aviation is overdue. If the suggestions in the Board's report are adopted, the first step to be taken will be the initiation of a



MAP TO ILLUSTRATE THE AIRWAY SYSTEMS OF ASIA.

It will be seen that routes are already established in Burma and Siam, so that when the gap over India has been bridged, an overland route to Australia will be possible. At present there are diplomatic difficulties concerning flying over the Persian section, but an alternative route has been already planned by way of the Arabian peninsula.

600-mile flying boat service between Calcutta and Rangoon, to be followed by a link between Karachi and Calcutta, by way of Agra, that would complete 5,000 miles of the England-Australia airway and provide continuous communication between Cairo and Rangoon. It is proposed in the early stages that military flying boats of the British and Australian Air Forces shall maintain a service between Rangoon and Darwin.

In course of time the Indian terminal of the Indo-Egyptian airway is likely to be Bombay, rather than Karachi, while the Air Board advise early surveys in preparation for lines between Calcutta and Bombay and from Karachi to Lahore.

By next year the Dutch aircraft interests expect to have in regular operation a service linking their East Indian possessions. The existing Japanese system is reported to comprise lines between Tokio and Fukuoka, by way of Osaka, between Tokio and Sendai, Osaka and Dairen, and Sakai and Oita, while an ambitious programme of future development has been embarked upon.

An eastern state which has made greater use of aviation than many European nations of comparable size and greater wealth is Siam, which since 1922 has had in operation a weekly air service in both directions between Korat and Ubon, *via* Roi Ech, and extended the line in 1924 to Nong Kai. In the same year a branch line from Roi Ech to Udon was established. The system is operated by Siamese pilots of the Royal Aeronautical Service, who have been trained by French instructors and equipped with machines of French manufacture. Few countries have made so extensive a use of the *aérochir*, or " flying ambulance," as Siam, six of these machines being maintained for the conveyance of doctors, vaccines, and patients urgently requiring treatment for snakebite and fever, to the Bangkok Pasteur Institute.

In the early part of this year the French have also promoted a weekly air mail service in their own province of Indo-China, serving the towns of Saigon, Kratie and Savannakhet. When this line is extended, as it is proposed, to Hanoi, the 800-mile journey is expected to occupy twelve hours.

The Australian system. No part of the British Empire has made so great an advance as Australia in applying aircraft to commercial use. The towns of

its western coast, from Perth in the south to Derby in the north, are linked by a weekly air service which until recently enjoyed the distinction of being the longest airway in the world. In the east, weekly services are also maintained from Camoweal to Charleville, a distance of 825 miles, and from Adelaide to Cootamundra. The last-named line is supplemented by branch "feeders" from Melbourne and Broken Hill over which machines ply twice a week to make connexion with the main service. The Commonwealth Government has called for tenders for the operation of an air line from Perth to Adelaide, which would connect the eastern with the western systems, while negotiations are proceeding for a flying boat service between Tasmania and the mainland.

The further extension of the England-India airway will demand the continuance of the Charleville-Camoweal link to Darwin, while other lines projected are those between Cloncurry and Normanton, Charleville and Brisbane and thence to Sydney, and Charleville and Melbourne.

The North American system. As in so many countries, the story of American civil aviation since the war is one of unrealized anticipations and of neglect. In spite of the incentives provided by its wide spaces and scattered populations, America has so far failed to develop commercial flying even to the extent of European powers with less spacious territories and far fewer financial resources. Even though great progress was undeniably made last year and the lines now established challenge comparison, in point of length, with any in the world, they are used chiefly for the carriage of mails, passengers providing only an incidental source of income for a few lines and being entirely unprovided for on most. The great transcontinental line which spans America from New York to San Francisco, a distance of 2,665 miles, was, until this year, operated directly by the Post Office Department, utilizing a fleet of nearly a hundred Air Force machines. The carriage of the air mails is now undertaken by independent commercial companies, and subsidiary lines connecting the transcontinental with Seattle, Pasco, San Diego, St. Paul and Fort Worth are operated under contract in a similar manner. Many extensions of ambitious length are, however, projected and great activity is being displayed in equipping aerodromes with the lighting and other ground equipment necessary for night flying.

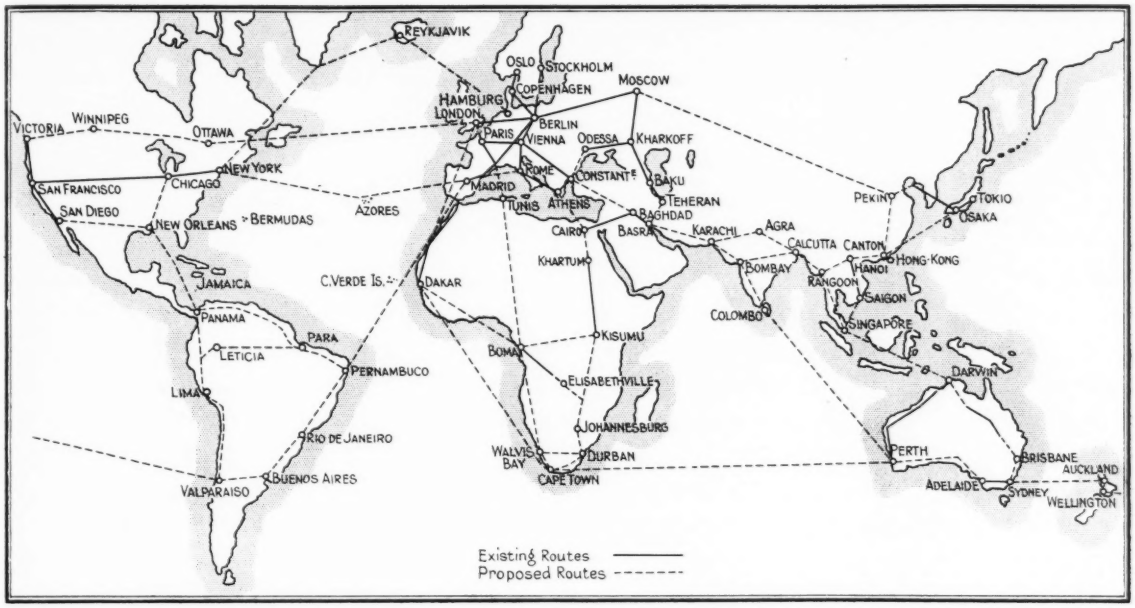
THE AUSTRALIAN SYSTEM.

Without doubt Australia is the most developed part of the Empire where aviation is concerned, and large sections of the continent are linked by regular services.

Air Mails.

Although mails have hitherto been the staple traffic of all the lines established, there seems no reason why urgent freight and passengers should not be as remunerative a portion of aerial traffic in America as they have proved in Europe or, in more comparable circumstances, in Australia. The factor which has hindered the development of these traffics in the States has probably been that the form taken by the support accorded by the Federal Government has been that of contracts for the carriage of mails. The contracting companies have, therefore, specialized their equipment and their schedules for this traffic, employing comparatively small, single-engined, open aircraft calculated neither to inspire confidence nor to provide comfort. The commission of multi-engined, enclosed aircraft, such as are becoming the standard passenger equipment on the European air lines, may be expected to open a new phase of civil aviation in the United States.

The Future World Airways. The regional method adopted for the foregoing survey of the world's airways may have obscured the contention with which the first article opened—that the full economic justification of aircraft lies in its employment over the longest possible distances, and that its function is to knit together nations and continents and not merely to promote political and nationalistic schemes aiming at exclusive regional development in times of peace, and capable of serving military ends in emergency. The map opposite showing the probable main air routes of the not very distant future may help to focus the whole subject in truer perspective. The



THE PRINCIPAL AIR ROUTES OF THE WORLD, PRESENT AND FUTURE.

use of Mercator's Projection may, however, cause one suggestive fact to be overlooked, and that is the potentiality of the Arctic and sub-Arctic in the development of aerial communication between the towns of the temperate belt of the northern hemisphere.

Stefansson, an enthusiast for the Arctic, is a warm advocate of this aspect of airway development. He claims that the Arctic, owing to the equable temperature of its long "day" and "night" would provide ideal flying weather for airships, which would be able to fly from northern Europe in spring or summer, cross the Arctic and penetrate some distance into Asia before encountering night. The fact that the journey from Britain to Japan, *via* Spitzbergen, Franz Josef Land, Emperor Nicholas II Land or Cape Chelyaskin, and thence overland, is 3,000 miles shorter than the route *via* Montreal and 2,000 miles shorter than the journey by the Trans-Siberian railway, is sufficient justification for a prophecy that the Arctic is likely to have a greater significance in the world airway system than this generation, over-familiar with the map according to Mercator, would be likely to consider possible.

The social and political implications of the airway form a subject too important and too suggestive to be relegated to a paragraph at the end of an article that has sought only to convey facts and to limit speculation to immediate possibilities. It is necessary to say, however, that just as the progress of civil aviation is conditioned by the readiness with which it is realized that the trade and customs regulations suitable to a sea-and-rail transport era are out of date in the aerial age, so the development of flying itself will help to destroy many hindrances to trade which the nations have erected on their frontiers. The benefits of aviation can only be bought at a price, and that price is the abandonment of insularity and selfish forms of nationalism.

One may confidently predict that the cause of international peace is likely to gain from the progress of commercial air transport, not, perhaps, because contact between peoples always inclines them to like the other better, or, indeed, because the mass of the people will have the means to utilize directly the new form of communication; but because the intercourse that is promoted may minimize the disposition to credit the foreigner with those diabolical attributes that are an inevitable preliminary to war fever. It is an axiom of historical science that the rapidity and efficiency of communication determines the size of the administrative unit. It may not be extravagant, therefore, to suggest that a growing sense of the smallness of the world will in time make a war between nations seem as unthinkable as a present war would be between counties and provinces; and that through the agency of the airway the nations will gradually become more firmly united.

Recent Developments in Ultra-violet Irradiation.

By C. A. Cooper.

The use of "artificial sunlight" for medical purposes has led to much research on improved methods, while ultra-violet irradiation also has interesting possibilities in its newest commercial applications.

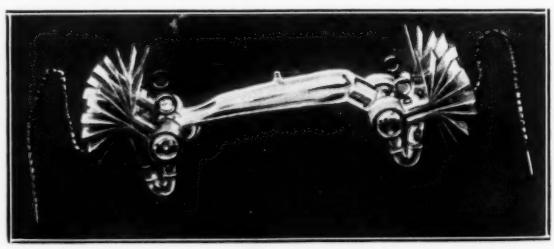
ULTRA-VIOLET rays were first used in therapeutics by Finsen in 1893, and while progress was then slow, the experience gained in succeeding years led to artificial sunlight treatment on a considerable scale during the war. There are two reasons why these rays have unquestionable and precise curative powers. Firstly, they possess definite germicidal and bactericidal properties, with consequent blood purifying effects, and secondly, they exercise a highly beneficial influence on the nervous system. Unlike X-rays, their degree of penetration is only slight, about 1/16th of an inch through the skin, and during the exposure to them the blood conveyed through the capillaries and veinules is continuously subjected to the effect of the rays, wherever they are directed. The nervous system is similarly benefited through the ramifications near to the surface of the skin.

FINKEN BURNER 1893.

The most rapid strides have been made during the last few years, particularly quite recently, and I think that in the near future much greater scope will be found for this remedial agent, apart from its commercial and industrial use, which is speedily extending. Originally the endeavour was presumably to produce light giving the solar spectrum simply in order to replace natural sunlight. Long exposure was given to sufferers from certain troubles—rickets in children, tubercular affections, under-development, rheumatism, etc.—with good results, but it was appreciated that these could be much improved upon.

Means were sought to generate a more intensive volume of ultra-violet rays and various electric arcs were brought into use, increasing the range to 1,850 Angstrom units.* The mercury vapour arcs used for lighting purposes were known to generate ultra-violet rays, but the glass tubes obstructed their passage. It was found, however, that pure quartz, transparent and glass-like in appearance, *did* allow of the passage of all the rays, and thus evacuated quartz mercury-vapour burners were evolved and produced. This entailed great difficulty and expense because, unlike glass, this material cannot be reduced to a molten state, and only skilled craftsmen, who were restricted in number owing to the long training necessary, could fashion fused quartz at about 2,000 degrees Centigrade into tubing and then into burners.

As compared with natural sunlight, in which one can bask for hours on end, only from thirty *seconds* to five *minutes* exposure to intensive ultra-violet irradiation is possible, at say six inches to three feet distance from the source, because of the erythema set up with the same effects as sunburn. I must diverge for a moment from my theme to emphasize the importance of the dosage and distance of high power units in medical use. An "overdose" of natural sunlight merely causes redness, tanning and peeling of the skin, but overdoses of ultra-violet rays are both unwise and useless. Pigmentation and peeling of the skin, excepting in certain specific cases of skin diseases, have no therapeutic effect, and it is utterly useless to give further treatment until all traces of erythema have completely disappeared:



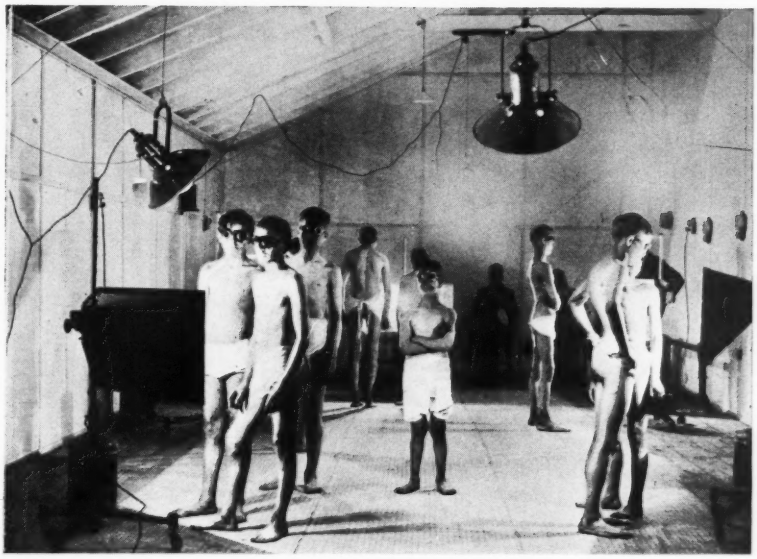
A MODERN ULTRA-VIOLET BURNER.

ultra-violet rays will not penetrate coloured matter even to the fraction of an inch, and reddened or browned skin is non-receptive, although coloured liquids such as blood do absorb the rays on the surface. Tanned or freckled portions of the skin, peeling or dead skin, and corns and warts, obstruct the rays, although by concentrating the rays on these growths,

* The Angstrom unit is used in expressing wave-lengths of light and measures one hundredth-millionth of a centimetre.

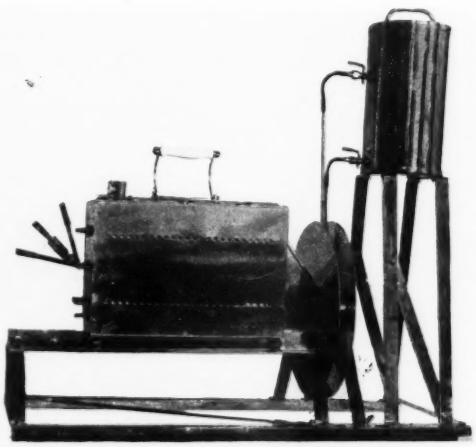
combined with the heat and slight volume of infra-red rays, they can be completely removed.

The latest theory which I believe to be nearer the ideal is that very *short* exposures should be *repeatedly* given. Instead of say three minutes treatment at thirty inches given once daily, the dosage should be one minute at three feet three times daily, thus preventing erythema or pigmentation of the skin and the consequent obstruction to the ultra-violet rays. Another method of equally recent evolution is to give treatment by the rays to the whole body in four instalments, so to speak, on consecutive days—the front of the trunk, arms and face the first day, the back the second day, and the front and posterior lower limbs on the third and fourth days, continuing the treatment in this order for a given period. Incidentally, as it is solely by the penetration of the rays through the skin to the blood and the nerves that the beneficial effects are obtained, it is always advisable to expose all parts of the body to the ultra-violet rays, and it must also always be borne in mind that they do not penetrate clothing of any kind.



ARTIFICIAL SUNLIGHT FOR MINERS.

Above is illustrated a "sunlight" clinic which has been installed at the pit head of the Sherwood Colliery, Mansfield, where miners straight from their shifts are given daily sun baths. Data are kept as to the health of the miners.



APPARATUS FOR TREATING LIQUIDS.

This apparatus is one of the latest applications of ultra-violet light now under research. The liquid is placed in a small tank between the circular vanes on the right. The rays pass through a water-cooled quartz lens, and the vanes, as well as the water, carry away the heat so that only ultra-violet rays reach the liquid.

Having described already the mercury vapour type of burner, I will now refer to other sources of production. Metals, such as tungsten, iron, and nickel, are prolific in the emission of ultra-violet rays when an electric arc is formed with them. Tungsten is very good, but it can only be used on "direct" electric current, and another drawback is the smoke from it. Many doctors nevertheless prefer it to the extent of installing special plant to use it when "alternating" current only is available. Even iron nails will give a good spectrum, either alone or combined with nickel or tungsten, but not exactly what is required, as the hand feeding necessitated is not practical and continuous variation in production is unavoidable.

Metal-cored carbons are certainly of immense value because pulverised tungsten, for instance, can be used with all electric currents. Special impregnated carbon rods are cast with a hollow centre into which various powdered metals are forced; the carbon shell, treated for the purpose, burns evenly and steadily and the "core," whether of one metal or a mixture of metals, is consumed at the same time. Carbon arcs used for street lighting are so devoid of ultra-violet rays that they are useless for curative purposes.

In commerce and industry there is no limit to the possibilities of the use of these rays, from simple colour-testing to the treatment of foodstuffs. Philatelists can, with their aid, sort "the wheat from the chaff," for forgeries are unfailingly discovered

and fraudulent marks brought to light. The coloured material manufacturer of fabrics and ribbons can ascertain if his dyes are "fast" by simple exposure to the rays, and he can safely guarantee after such treatment that his products will not fade in sunlight.

Water is completely sterilized by exposure to ultra-violet rays, although the process is not exactly commercialized as yet because of the cost of the complicated plant necessary, which is not yet made on a proper production basis. There are also difficulties in manipulation and in checking results.

Finally, the treatment of foodstuffs is of immense importance, because of the increase of nutritive value. The illustration on page 61 shows experimental apparatus specially designed for increasing vitamin D in liquid foods; good food is made better, poor food is improved, and it is found that the ripening of fruit, cut while green, is hastened and attains a nearer stage to the real sun-ripened fruit. Bakers also are flooding their ovens with the rays; I have no data on this departure, but I am satisfied that there should be positive improvement in the food-value of the bread if treated while doughy, because, as with the skin, there is greater receptivity when dampness prevails.

I cannot here describe the various apparatus for generating ultra-violet rays, but a number of first-class British manufacture are already on the market.

Among the Stars: A Monthly Commentary.

By A. C. D. Crommelin, D.Sc., F.R.A.S.

THE FACE OF THE SKY FOR FEBRUARY.

THE winter constellations, Orion and Taurus, are now declining in the west, and the spring ones, Virgo and Bootes, appear in the east. Only one of the major planets is in the region of our map; that is Neptune, a little to the west of Regulus. February and the two following months are the best time of the year to look for the zodiacal light in the west after dusk. It is useless to attempt this in towns, an absolutely dark sky without moon being essential for seeing this very delicate luminosity; as its name implies, it lies along the zodiac, through Pisces, Aries, and Taurus. If it should be seen, the position of its edges among the stars should be noted as accurately as possible and communicated to some astronomer interested.

Composition of the Gaseous Nebulae.

The gaseous nebulae give a spectrum of bright lines, some of which have for a long time been identified as belonging to hydrogen, nitrogen, and helium; but there were some lines that could not be identified with any known substance, and a hypothetical gas was assumed to exist there, to which the name Nebulium was given. But the increase of knowledge concerning the atom has shown that there is no room in the element table for new elements, except perhaps a few of great atomic weight. It was then concluded that the Nebulium lines were really due to some familiar element in an unfamiliar condition. Professor H. N. Russell contributes an article to the "Scientific American" for January in which he explains the recent investigations of Dr. Bowen, which have traced the origin of nearly all the unknown lines as being due to the two gases oxygen and nitrogen, which between them compose about ninety-nine per cent. of our atmosphere. When gases are at ordinary pressure, or even at the low pressure of a so-called vacuum tube, the atoms collide very frequently, and change their amount of energy at each collision. In the course of these changes they pass occasionally through "metastable" states, in which they have given out nearly all their energy, and do not radiate light under ordinary conditions. But at the extraordinarily low nebular densities (a cubic mile containing less gas than a cubic inch of atmosphere) collisions are extremely rare, and the metastable atoms get a chance for radiating light before their condition is changed by a collision. The pair of lines at wave-length 3725, 3728, is due to oxygen in this state, while a slightly different state in the same gas explains the line at 4363 in the violet and a pair in the green. The strong pair in the red is ascribed to nitrogen.

It is to be noted that the explanation has been derived from the theory of the atom, not by actually producing the lines in a terrestrial laboratory. If correct it removes what was regarded as one of the greatest mysteries of celestial spectroscopy.

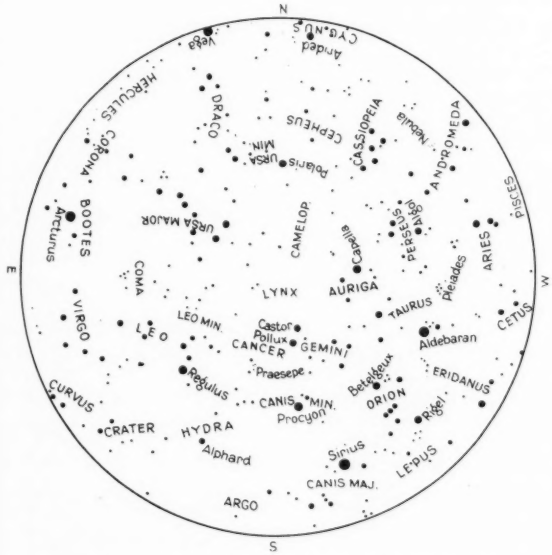
Photographs of Jupiter.

Professor Douglas, who took some remarkable photographs of Mars during the last two apparitions in light of various wave-lengths, has lately published similar series of photographs of Jupiter. The photographs give hope of determining the relative height of various marking; there are two ways of doing this. Firstly, the red images are notably smaller than the violet ones, showing that the outer layers of the Jovian atmosphere are opaque to violet light, but transparent to red. Secondly, photographs taken a few minutes apart, on combination in a stereoscope, throw the planet into relief, and cause the belts to stand out in three dimensions. One noteworthy point is that the great red spot is very strongly marked on the photographs in violet light but almost invisible in those in red light, showing that it emits almost as much red light as the neighbouring parts of the disc. There are very striking differences between the distribution of light and dark regions in the photographs of different colours, and it should be possible to locate each marking at its proper height in the atmosphere.

A Tantalizing Comet.

A brilliant comet was discovered by Mr. J. F. Skjellerup of Melbourne on 3rd December; Mr. Skjellerup had already found several comets when resident in South Africa, but this is his first since he moved to Australia. The comet was of the third magnitude, and was in the south-east in the morning twilight. Its tail was three degrees long, its length subsequently increasing to eight degrees. There were at least two other independent discoverers of the comet, Mr. Ross Fitchet at Grahamstown on 5th December, and Mr. Maristany at La Plata on

6th December. It was 54° south of the equator when found, but was rapidly approaching the sun. On 15th December Mr. Chidambarier, assistant at Kodaikanal Observatory, saw it in full daylight within two degrees of the sun; it was then several times as bright as Venus at its brightest, and must have been of magnitude minus 5 or minus 6. Daylight observations were also made at the Lowell and Yerkes Observatories and in Germany. Unfortunately the comet did not come as far north of the sun as was hoped from the orbits that were first published, and apparently only one observation was obtained in the British Isles by Mr. J. M. Patterson in Fifeshire. He saw it on Saturday afternoon, 18th December, from 4 to 4.15 p.m. in the direction south-west by south; it was clearly visible to the naked eye, brighter than a star of the first magnitude, with a tail of considerable length (about six times the diameter of the head). The orbit presented considerable difficulty in computation, as is generally the case in comets that approach near to the sun. Messrs. Wood of Johannesburg and Dawson of La Plata telegraphed elements when the comet had been observed for a few days, but these deviated considerably from the truth, through no fault of the computers. I had the advantage of a considerably longer series of observations, but still I do not claim the following orbit as anything more than an approximation. Perihelion passage 1927, 18th December, 18.61 Universal Time; Arc from node to perihelion 42° 56′, Node 81° 19′, Inclination 83° 52′, Perihelion distance 0.1822. or 17 million miles. The ephemeris shows that the comet remains near the sun till towards the end of February, and will then be best seen by southern observers. The orbit bears some resemblance to that of the bright comet 1860 III, but I don't think that identity is probable. When the comet was first found I thought it might be the return of De Vico's comet, 1846 IV, but the perihelion distance is too small for that to be possible. It is tantalizing that the brightest comet for many years should have passed without our being able to see it. There were ten comets discovered in 1927; the record year was 1925, with eleven; 1898 had also ten.



THE FACE OF THE SKY AS SEEN FROM LONDON at 8 h. sidereal time; at 11 h. p.m. on 5th February, and 10 h. p.m. on 20th February.

Correspondence.

X-RAY ANALYSIS OF CRYSTALS.

To the Editor of DISCOVERY.

SIR,

On the second page of the January number of your magazine you make a generous reference to an account which I gave in a Royal Institution lecture of some recent work on the structure of the silicates. The advance is due to my son, Professor W. Lawrence Bragg, of Manchester University, and to his colleagues, as I was careful to explain in the course of the lecture. From your note it might be inferred that I could claim the credit for myself. I should be grateful if you could publish this letter so that your readers may be correctly informed on this point. It happens often, and naturally, that my son and I are confused with one another; we are both working on the subject of the X-ray analysis of crystals. But, as you will readily understand, I am most anxious that credit should be given where it is due.

My son himself gave a description of the results of his research on the silicates in a Friday Evening Discourse at the Royal Institution, which was subsequently published in *Nature* for 17th September, 1927.

Yours faithfully,

The Royal Institution, W. H. BRAGG.
London, W.1.
2nd January, 1928.

A LINK WITH OVERSEAS.

To the Editor of DISCOVERY.

SIR,

As a former reader of *Conquest*, and now of *Discovery*, I look forward very keenly to my copy every month. Out here we live rather prehistoric lives. It matters not if the mail train is six hours late or three days during the rainy season—that's a mere detail, and when my *Discovery* arrives I look forward to seeing how things are going at home. The article in the September issue on the Bristol University was very interesting, as Bristol is my home town and when I left in 1920 they had just started building. Since I left home and arrived here, now nearly eight years ago, I have never set eyes on the sea, and I know of several people of twenty-five years old who have never seen the sea yet.

I should like to suggest, however, that we have a few articles, especially for overseas readers, dealing let us say with the latest "Underground" in London or the automatic telephone exchanges which I believe are being installed. In *Conquest* there used to be several articles during the year on the latest feats of engineering all over the world, and these seem now to have given way to discoveries of ancient men and buildings. Cannot we hear occasionally of something big done in Britain by Britishers?

Yours faithfully,

Bulawayo, S. Rhodesia. P. W. NELSON.

(The policy of *Discovery* embraces a wider scope than the journal it took over, but our correspondent has anticipated this month's article on the automatic telephone. We welcome his suggestions, no less than his appreciation of Bristol, a notable achievement in another sphere of British home activity.—ED., *Discovery*.)

Book Reviews.

The Army and Sea-Power. By MAJOR PARGITER, R.A., and MAJOR EADY, M.C., R.E. (Ernest Benn Ltd. 10*s.* 6*d.*).

It not infrequently happens that a reviewer lays aside a strategical book with thankfulness that his task of reading is completed, if indeed he has resisted the temptation to skim through its pages. "The Army and Sea-Power" is not, however, a book of this nature. Written in simple and lucid English, it traces the growth of English sea-power from its early beginnings to its culmination in the late war, and in such a manner as to render it not only a book of great value to students of combined strategy, but a book of engrossing interest to general readers, including boys who wish to know something of the sequence of events, the success and failure, and the ceaseless endeavour which has built up and utilized that sea-power. This book is therefore to be commended to all those who desire to obtain a brilliant little bird's-eye view of "sea-power".

It should not be supposed, however, that this is a "popular" book in the less worthy sense of that word. It tells a plain tale of success and failure which by its very simplicity sets forth the first principles of a sound Imperial strategy, first principles which we can only disregard at our peril. It is noteworthy that this able study of sea-power comes from the pens of soldiers, yet it is by sailors in particular that its lessons should be taken to heart. Few of us probably realize how great a part the army has played in the building up and maintenance of our dominant sea-power, and at the present time, as in the past, we have much to learn from those soldiers who appreciate not only what ships can do but, of greater importance, what ships cannot do and should not attempt to do.

The authors emphasize the historical failure of ships against shore defences, but has the Navy even yet learnt its bitter lesson? The necessity of the defence of Fleet bases by the Army is ably expounded, a necessity which the Navy certainly appreciates. Does the Navy, however, trust the Army sufficiently, or does it devote undue effort and material to local defence schemes of its own at the expense of fighting and mobile strength?

The success of combined operations is repeatedly shown to lie in surprise, and few, if any, examples are given of a successful landing from ships in the face of powerful and prepared opposition. The awful shambles that must arise from a landing in the face of modern weapons and defences should surely rule such operations out of any sound strategical plan. In the closing chapters, which deal with the late war, the authors pass over highly controversial matters with a light and unprovoking hand, realizing, as indeed they admit, that we are still too near these tremendous events to analyse them with that detachment which is so very necessary for sound judgment. It is in these closing chapters, however, that "The Army and Sea-Power" is most liable to give a not entirely correct impression of certain important aspects of the naval operations of the late war. The intense loyalty of the Army to the senior service precludes the authors from differentiating adequately between victory and non-victory in a great sea fight, and leads them into the common error of supposing that the Navy obtained the fruits of victory by the escape of the German Fleet intact into her harbours, with the eventual ignominious surrender at the close of the war. Nothing could be further from the truth.

While the terrible losses from submarines are legitimately compared with the losses we sustained in the Napoleonic wars from the action of frigates and privateers, the authors clearly share the widely held view that submarines are still a menace of dangerous proportions. They overlook, however, the startling limitations of these piratical craft when countered by the sound and unanswerable tactical defence of Convoy and Group-sailing, a method of defence introduced during the last ten minutes of the twelfth hour, and with dramatic results.

The Singapore scheme receives, perhaps, a greater blessing than it deserves, but it could hardly be expected that its strategical aspect would be called in question by military staff officers in the face of official naval opinion.

This book will interest and repay all readers, whether laymen, soldiers, or sailors.

B. ACWORTH.

Illustrations of the Methods of Reasoning: A Source Book in Logic and Scientific Method. By DANIEL S. ROBINSON, Ph.D., Professor of Philosophy in Miami University. (D. Appleton & Co. 8*s.* 6*d.*).

Old-fashioned teachers of logic seemed to take pleasure in emphasizing the formal aspect of the processes of reasoning, and in disguising the fact that, ordinary arguments being arguments about something, their cogency, or the reverse, is best illustrated for beginners in examples where this is evident from the subject matter as well as from the logical form. The alternative method, in which logical rules are disengaged from a number of examples in common speech, like any other scientific generalization, is more commonly employed in America than here; but Professor Robinson's book will be welcome as an auxiliary, both by lecturers and more enterprising students.

The plan of the book is fairly comprehensive, for it begins with the traditional Aristotelian logic, given in brief outline, with an ample list of examples under each head, and it ends with reprints of the chapter on the Methods of Experimental Enquiry from J. S. Mill's "Logic" and Tyndall's "Scientific Use of the Imagination." But the more characteristic sections lie between. Under the general headings, "Classification," "The Method of Sampling," "Statistics," and so forth, the principal stages of scientific procedure are stated in outline, supplemented by a short list of useful books, and illustrated by actual examples drawn from the newspapers, from specialist treatises of all kinds, and from that useful compendium of current discovery, the *Daily Science News Bulletin*, to which we have at present nothing analogous in this country, though it is satisfactory to note how large a number of these terse outlines of scientific procedure are derived from the columns of *Discovery*. Naturally, the largest series of examples is that which illustrates Mill's experimental methods, and the "complete method of explanation" where verification has been achieved subsequently. But the sections on "Analogy and Circumstantial Evidence" and the "Historical Method" are well furnished also, and will appeal to another class of students, in the "human" sciences. They are the more suggestive because historical analogies are associated with similar arguments in physics. In a second edition the "historical method" should similarly be illustrated from geological and palaeontological discoveries, and from evolutionary discussion of technological problems such as have been the life work of Pitt Rivers, Haddon, and Henry Balfour in England, and of Franz Boas in America.

It does not at all detract from the primary object of this book, that it is a feast of scientific gossip; and as the sources of the extracts are given, it is easy to follow up the subjects with which they deal.

J. L. MYRES.

Life in the Stars. By SIR FRANCIS YOUNGHUSBAND. (John Murray. 10*s.* 6*d.*).

The author, in the course of his numerous expeditions to lofty mountains and lonely deserts, has had unrivalled opportunities for studying the majesty of the star-lit heavens; in recent years he has visited some of the great American observatories. The opening chapters of the book give a simple and poetic description of the important advances in sidereal astronomy that have been made in the present century, and the marvellous expansion in our conceptions of the size of the visible universe, and of the duration of the life of a star as a luminous body. He gives an outline of the hypothesis that the planetary system was formed by the expulsion of matter from the sun owing to the tidal action resulting from the approach of another star. He notes that such near approaches of stars to each other would be very rare, but that since our stellar system contains thousands of millions of stars, even if only one star in a million were the centre of a planetary system, there might still be thousands of planetary bodies in the stellar system that were suitable for habitation by high forms of living creatures. This cannot be claimed as a certainty, but few will be disposed to deny that it is a reasonable hypothesis. He elaborates his thesis from a variety of standpoints, and justly insists on the clear evidence of creative design that may be seen in the universe. He says "Surely it could not have been by a pure fluke that such a marvel as man arose out of the sun? Surely blind forces could not have produced so marvellous a result."

There are naturally a few points on which opinions will differ. Those who believe that "In the beginning God created the heavens and the earth" will dissent from his view that the material universe had no beginning, but existed from eternity. His assumption that the earth will remain a habitable world during the whole of the millions of millions of years that measure the life of a star (according to some cosmogonists) is unjustified. For the greater part of that long period the sun will give only a very small fraction of the light and heat that it now does; it is probable that its reduction to one half of its present amount would render the earth uninhabitable by higher organisms.

There are a few slips on matters of detail that should be corrected. On page 21 it is stated that the great American telescopes will photograph stars down to the thirtieth magnitude. This is too low by several magnitudes. On page 94 the author says that the combination of hydrogen and oxygen to form water cannot be effected in the laboratory; most of us saw the experiment performed in our school days. These, however, are trifles. The book as a whole is calculated to give an enhanced idea of the wonder and majesty of creation.

A. C. D. CROMMELIN.

Archimedes, or the Future of Physics. By L. L. WHYTE. (Kegan Paul. 2*s.* 6*d.*).

To the young research student casting around for some niche in which to fit himself, physics often seems a worked-out subject. The mentalities and contributions of past and present physicists have set such a high standard, that the newcomer is a little fearful to tread on such august ground. To all such earnest people, this book will be an inspiration. The writer, blessed with that *rara avis* of scientific writing, a lucid style, has no illusions regarding the glamour and glory of physics, the infallibility of scientists worshipped as gods, or the theories which by constant repetition become laws. He is a clear and fearless thinker, and he solves the problem of the future development of the science in the common-sense manner, that is, by a careful consideration of the tendencies of the present. His writing has no taint of the modern method of prophecy. His method follows the lines of a true experiment—searching observation followed by an exhaustive and careful inference.

The two modern philosophies, introduced by Einstein and Bergson and elaborated by their followers, are shown to differ fundamentally in the question as to whether physical laws are reversible or irreversible. He holds a careful balance between the two, and his analysis shows that through Bergson's theories, physics will ultimately be allied to the biological studies, that is to say, the study of inanimate matter will assist in our understanding of the riddle of life.

J. F. L.

The Life of the White Ant. By MAURICE MAETERLINCK. Translated by ALFRED SUTRO. (George Allen & Unwin. 6*s.*).

This book is an essay after an extensive reading of the literature on the Termite, but unfortunately the author, who is not a biologist, has constituted himself a champion of certain views as to the psychology of these interesting insects and has apparently frequently lost himself in rhetoric.

The language, which, of course, is Sutro's translation, is beautiful and sometimes dramatic, but its meaning, if it has any, is often obscure. The first eight chapters are an excellent essay on the life and habits of the insect but, after that, we pass to the occult power, morality, destiny, and question of instinct and intelligence, and it is in these chapters that the author contradicts himself, praises the insect to the detriment of man asks innumerable and unanswerable questions, and is most pessimistic about everything, except the insect, which he regards as a very dirty but intelligent little animal.

He compares the termitary—and also the beehive and ant-hill —to a single individual, "with its parts scattered abroad" (p. 144), so that the Termite is thus a single immortal insect, and he says (p. 199) "for these millions of years the same insect has gone on living, with the result that not a single one of its experiences has been lost." Yet, referring to the human species (p. 165), he says, "When we think of the eternities that have been . . . there would seem no doubt that civilizations similar to our own, or vastly transcending them, have existed in other worlds and perhaps on this earth. . . . Do we ourselves derive any advantage? Perhaps we do; but the gain, if any, is so slight, buried so deep down in our subconsciousness, that we cannot readily trace it. And even if we could, there would be no sign of progress; but only retrogression, vain effort and barren loss."

On p. 165 he says, "a slight fall in temperature in the equatorial regions and the entire species (meaning the Termite) will be destroyed, . . . " But on p. 177 he suggests that change of climatic conditions may have caused the Termites to adopt a subterranean existence. On p. 176 he asks, "is . . . intellect itself any more than a name that we give to one of the spiritual forces that we least understand," whereas on p. 141 we find "we have not the smallest idea of what instinct is, whereas we do, rightly or wrongly, believe that we know something of the nature of intellect."

He says that all this earth has produced so far is "a nameless hopeless distress" (p. 180), and "why should that which never has been or never could be have any chance of ever living?" (p. 181), or again, "If this has never been done, what ground have we for hoping that it will ever be done?" (p. 166), and similar melancholic remarks.

He compares the polymorphism of Termites and their powers

of producing the right kind of individual according to the needs of the community, with human productions of machinery. " Is that not an invention that goes far deeper into the secrets of nature than the inventions of the telephone or wireless telegraphy ? " (p. 178).

Maeterlinck is not a Fabre because he is not an entomologist, but possibly some readers may regard this as an advantage !

FRANK BALFOUR BROWNE.

The Fellahin of Upper Egypt. By WINIFRED BLACKMAN. (George G. Harrap & Co. 15*s*.).

Miss Blackman's study of the modern peasants of Upper Egypt is an open door to romance. For six years she has lived in intimate touch with a people who have preserved their identity for five thousand years at least—a people who, though they lived at the junction of the eastern and western waterways of the Old World, and consequently were subjected to many cultural and racial admixtures, yet in the end were strong enough to breed out or subdue the foreign strain. In this volume, which is a book primarily for the general reader, Miss Blackman has recorded a small part only of the material which she has gathered, and yet still more remains to be done in the field. Here she deals with the everyday life of the individual, with his social environment, his industries and agricultural pursuits and festivals and some of his beliefs—magic, the medicine man, and the evil eye. In her chapter on Moslem sheikhs and Coptic saints she opens up a subject of great importance to which she proposes to devote a future volume. Her study of the women and children and the aspects of life in which they figure most prominently, birth, marriage and fertility, are specially important for the student of survivals and origins in view of the marked conservatism of women in such matters. The chapter on ancient Egyptian analogies, though again only part of the material, will show how much of Ancient Egypt survives if we only know where to look for it. When once this is recognized this material may afford a key to the meaning and purpose of many obscure relics of the beliefs and practises of the Ancient Egyptians. One instance must suffice. Clay balls containing infantile hair of which the purpose could only be conjectured have been found at El-'Amarneh and Lahun. Exactly similar balls containing the tufts of hair shaved ceremonially from the heads of young boys in performances of a vow are buried by the modern people outside the tombs of the Moslem sheikhs or Coptic saints at which the ceremony takes place.

E. N. FALLAIZE.

An Art Student and his Teachers in the Sixties, with other Rigmaroles. By W. S. SPANTON. (Robert Scott. 7*s*. 6*d*.).

The author, with engaging candour, calls this book a " rigmarole," and it would be hard to find a more apt description, provided we attach to that word its more kindly meanings, and reject the more defamatory. The dictionary will justify the assumption that a rigmarole is tedious, long-winded nonsense, but Mr. Spanton's writing cannot be stigmatized with any such epithets. But " disjointed talk " is equally a dictionary definition, and this certainly fits the case. Almost as though he were gossiping by the fireside Mr. Spanton has gathered together a series of fragmentary reminiscences which date back to student days, first at Heatherley's Art School and later at the Royal Academy. Many of the names mentioned are those of artists who subsequently came into prominence; others have been long since forgotten together with their nicknames and peculiarities of manner which he gives in detail. This kind of thing is full of interest to those whose memories can carry them back to the 'sixties and 'seventies. To others one feels that its value is less that of a matter of immediate concern than that of a reserve of illuminating information available if required. But the small volume contains much more than this chronicle of small beer (which as a beverage is good in its way though it doesn't get you much " forrader "). The very readable chapter on Charles Fairfax Murray is full of entertaining things about Rossetti, Burne Jones, William Morris, and the pre-Raphaelite atmosphere and, indeed, many other matters. It may be gathered, then, that the book is one which should be in the hands of all who are interested in the art history of the second half of the nineteenth century, and this, we think, may be truly said for it. But we feel bound to add that if it is to be of practical use to them they will need to make a far fuller index than the one provided. There are, to take an instance, numerous references to Ruskin whose name does not appear in the index at all.

C. E. H.

Hunting under the Microscope. By SIR ARTHUR SHIPLEY, G.B.E., F.R.S. (Ernest Benn Ltd. 8*s*. 6*d*.).

In this book are collected together some articles which Sir Arthur Shipley contributed to *Discovery* on microscopic organisms. For some while he had intended to print them in book form, and after his death the unrevised manuscript was found among his papers. Sir Arthur had, however, already named a collaborator in Mr. Carl Pantin of the Plymouth Marine Laboratory, who had worked with him on " Life," the popular introduction to biology published a few years ago. The editor has therefore had the advantage of knowing at first hand the author's methods, and the necessary revision has been undertaken in the way he would have wished. Thus, for example, in explaining certain technical terms a sentence or two is introduced into the text instead of as footnotes, which Mr. Pantin rightly remarks " break the reader's continuity of thought." The book, in fact, is a striking tribute to Sir Arthur's lucid writing. The articles were written over a period of more than three years, but scarcely any amendment has been needed, and the theme is maintained from one chapter to the next as if originally written for publication in collected form.

The Antiquity of Man in East Anglia. By J. REID MOIR. (Cambridge University Press. 15*s*.).

Mr. Reid Moir needs no introduction to readers of *Discovery*. His paper on the important excavations at Hoxne, which he carried out on behalf of a Committee of the British Association, will be fresh in their minds, and no further testimonial of his ability as a practical archaeologist and as an exponent of his results is necessary. In the present volume his work is of a more systematized character; but it is still in the main concerned with his own researches in the field, except when he deals with the Neolithic, Bronze, and later ages. Necessarily he does not confine himself to East Anglia. Prehistoric studies there are brought into relation with discoveries elsewhere. One such excursion outside the borders of his area, when he deals with the eoliths of the Kentish Plateau and the flints from Cantal in France, leads Mr. Reid Moir to the pregnant statement that he inclines to the view that there is evidence for the existence of man in the Upper Miocene, the stage in geological time preceding the Pliocene of the Tertiary Epoch, which, of course, goes far beyond what most archaeologists are at present prepared to accept.

This general survey of the present position of the study of prehistoric archaeology in East Anglia will serve at least one good purpose in bringing home to its readers Mr. Reid Moir's great services to the study of Early Man.

E. N. FALLAIZE.

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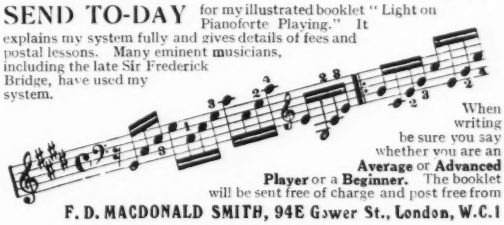

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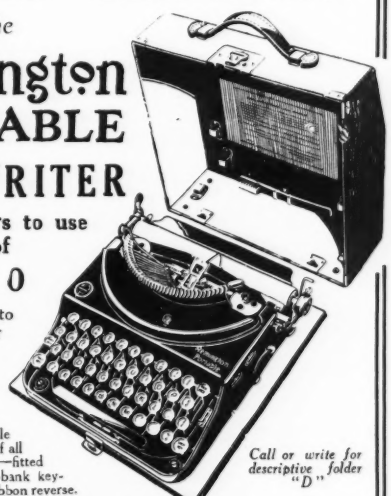

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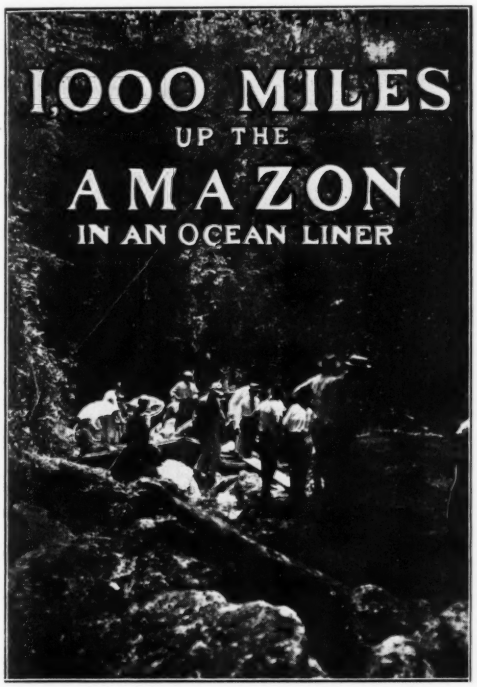

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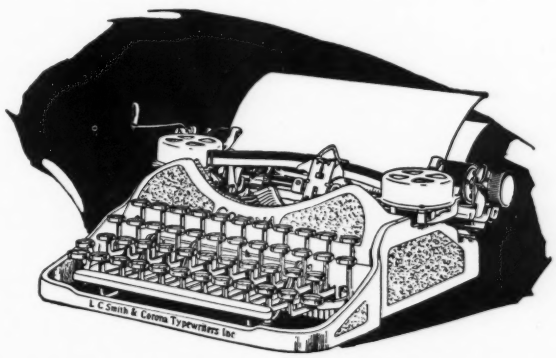

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